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# The Astoria Tunnel under the East River, New York City

By Harold Carpenter*

About fifteen years ago the Consolidated Gas Co., of New York City, for various reasons was compelled to look for a new site, outside of Manhattan and the Bronx, for future extensions of its operating plants. The impracticability of extending its existing plants, and the fact that many of its New York plants are located along the water front in the way of proposed water-front improvements by the city and are liable some day to be condemned by the city for public use, were among the reasons which required this action. Up to the present, three of the company's plants have already been taken by the city for such purposes.

The company accordingly purchased about 400 acres of land at Astoria (on the northwest corner of Long Island and about a mile and a half above Hell Gate) and designed a layout of plants suitable to the property, which at some future time will be capable of manufacturing all the gas used in Manhattan, the Bronx and parts of Long Island. The ultimate future capacity of this plant will be 240,000,000 cu.ft. of gas in 24 hr., larger than any similar works in the world. Of this layout, units of a capacity of 40,000,000 cu.ft. in 24 hr. have already been built and are in operation (see Fig. 2).

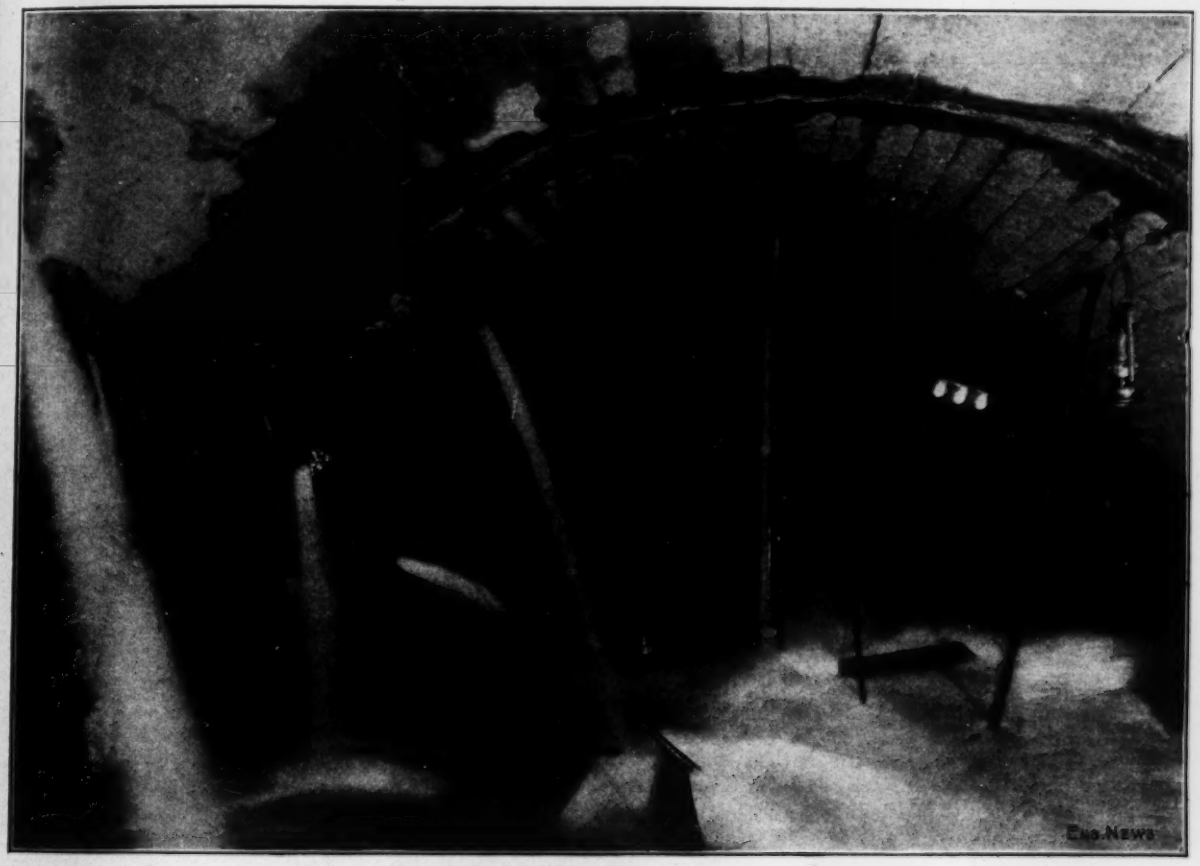


Fig. 1. A Heavy Flow of Water in the Astoria Tunnel

(Feb. 8, 1913. Flow at this time 4400 gal. per min. The flow from a bad seam at left corner of face is bulkheaded off, and the water has backed over the arch and flows in through grout pipes. This section of heading was temporarily lost.)

Up to the present time the gas manufactured at Astoria has been conveyed to New York City by means of a 5-ft. main running from the Astoria plant south about 2½ miles to the Ravenswood works and two 3-ft. pumping mains from there through the East River Gas Tunnel,* which was completed in 1894, to 71st St., Manhattan.

The plans for the plant, however, necessitated the building of a large tunnel directly from Astoria to the growing northerly district of New York City, the bor-

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*See "Engineering News" of Mar. 1, 1894, p. 172, for a general description of this tunnel.

ough of the Bronx. Due to the enormous increase in population of that borough, from 88,908 in 1890 to 430,980 in 1910 it became necessary to begin the construction of this tunnel at once. Work was started in the fall of 1910, and the tunnel is now completed except for finishing operations. During its construction the Bronx population has further increased to nearly 600,000.

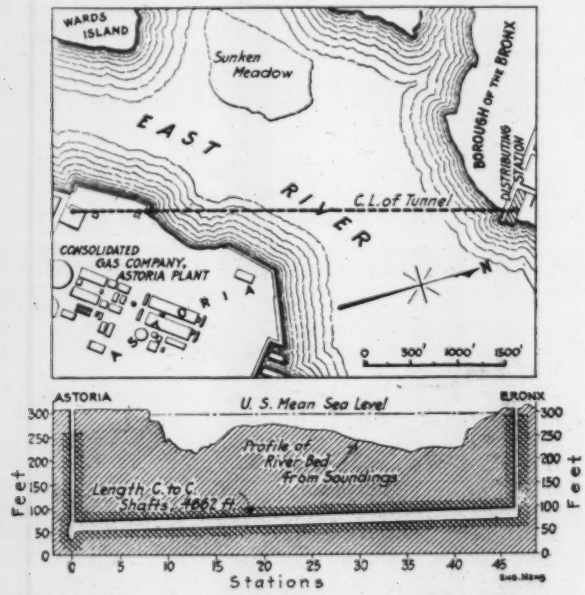


FIG. 2. PLAN AND PROFILE OF THE ASTORIA TUNNEL

This tunnel is of special interest, partly on account of its size, the size of the gas mains to be installed, but above all for the very unusual difficulties met and overcome during its construction.

## GENERAL DESCRIPTION

The Astoria Tunnel extends under the East River, from the Astoria Plant of the Consolidated Gas Co., at Astoria, Long Island, to the future distributing station at East 132nd St. and East River, Bronx. The Astoria shaft is about opposite 120th St., Manhattan (see Fig. 2).

The tunnel runs in an almost north and south line, the line being exactly 16° 4′ 53″ east of north, and is 4662 ft. long c. to c. shafts. The Astoria shaft is 34 ft. 6 in. diameter and 276 ft. 9 in. deep and the Bronx shaft is 26 ft. diameter and 233 ft. deep. The total developed length of tunnel and shafts is 5171.79 ft.

The tunnel has a downgrade toward the Astoria shaft of 0.5% (a 23-ft. total fall), so that all drainage will be pumped from the Astoria shaft (see profile in Fig. 2).

The cross-section (Fig. 3) is D-shaped, except that the bottom is slightly concave, and is made up entirely of arcs of circles, the excavated section having a width of 19 ft. 9 in. and a height of 21 ft. Both the shafts and tunnel are lined throughout with concrete from 18 in. to 36 in. thick. In the tunnel this lining is reinforced with steel rods where necessary through bad ground, and one section of 50 ft. was reinforced with cast-iron lining back of the concrete. The completed cross-section of tunnel inside of concrete lining has a width of 16 ft. 9 in. and a height of 18 ft.

There is a minimum cover of 125 ft. of rock between the bed of the river and roof of tunnel. The maximum water depth in the river is 90 ft. below mean level (see profile, Fig. 2).

## GEOLOGICAL FORMATION

The general geological formation consists of Fordham gneiss at both the Astoria end and the Bronx end of the tunnel with Inwood dolomite between them.

Borings to a depth below the invert of the tunnel at the Astoria end, as well as numerous other borings at the gas plant, including one 2000-ft. hole for a well, showed solid rock from a point 50 ft. below the surface; a test shaft at the Bronx end disclosed bedrock 13 ft. below surface. Wash borings in the bed of the river disclosed rock at depths varying from 25 ft. to 90 ft. below mean sealevel.

From geological information available, including that determined by the East River Gas Tunnel built in 1891, it was known that trouble might be encountered on the westerly contact between the dolomitic limestone and the Fordham gneiss, but by carrying the tunnel through at as low a level as other considerations made possible, being over 100 ft. lower than the old tunnel, it was hoped to minimize this difficulty.

The Astoria shaft and the south end of the tunnel extended through Fordham gneiss of varying characteristics up to a point about 1200 ft. from the shaft, where Inwood dolomitic limestone was encountered (see Fig. 6). This gneiss had a strike varying from 25° to 55° east and variable dip and contained seams and dikes of kaolinized gneiss and pegmatite, the former appearing especially on the contact between the gneiss and limestone.

The Bronx shaft and the north end of the tunnel extended through Fordham gneiss of varying characteristics up to a point about 750 ft. from the shaft, where Inwood dolomitic limestone was encountered. The gneiss was very uniform until at 600 ft. from the shaft a fault was found. At 650 ft. the first watery crevice occurred, and at 715 ft. seams filled with decomposed rock began to occur, becoming serious at the actual dolomite contact, 750 ft. from the shaft. The 400-ft. stretch beyond this latter point constitutes the trouble zone which will be described later.

Returning to the easterly contact between the Fordham gneiss and Inwood dolomite, 1200 ft. from the Astoria shaft: From this point northward to the southerly end of the trouble zone the limestone contained many igneous and metamorphic dikes and intrusions. Seams and dikes of kaolinized gneiss, decomposed limestone and chlorite; kaolinized limestone, mica and iron pyrites; quartz, white feldspar and mica; feldspar, quartz and mica with pure talc on either side; serpentine and asbestos, talc; granite from 5 ft. to 10 ft. wide; white and smoky quartz 12 ft. wide; gneiss; quartz and feldspar; and a dike of granite about 25 ft. wide; occurred in about the order named.

Among specimens found in different places throughout the tunnel including the trouble zone were: Garnets in the gneiss, seams of pure asbestos about ¼ in. thick, seams of pure talc 4 in. thick, actinolite, biotite, beautiful specimens of calcite crystals, differently colored dolomitic limestone (white, gray, brown, green, etc., both crystalline and noncrystalline), siliceous limestone, chlorite, hematite, hornblende, iron pyrites, kaolin, limonite, mica in transparent white sheets, muscovite, oligoclase

orthoclase, quartz, both white and smoky pegmatite, serpentine, tourmaline, tremolite. There were found also pockets of clay ranging in color gray, blue and red; seams of decomposed limestone; green and black mud and sand and beach sand.

A number of anticlinal and synclinal folds were encountered.

## Progress

Ground was broken for both shafts on Sept. 12, 1910, and, as the gneiss and limestone made a good rock for shaft-excavation and tunneling, good progress was made. The Bronx heading was turned on Feb. 12, 1911, and the Astoria heading on April 8, 1911.

The best progress in shaftsinking occurred in the month of March, 1911, at the Astoria shaft, with 52 ft. of shaft excavated in 25 working days, amounting to 2428 cu.yd. of rock in place, or 97 cu.yd. per working day.

The best average daily progress in the tunnel heading was at the Astoria end in May, 1912, with 17 ft. per working day of 24 hr., in three shifts. This meant the excavation of 100 cu.yd. of rock in place, and constitutes the world's record for volume of heading excavation. The heading was practically semicircular, constituting the entire upper part of the tunnel, and was driven at this time through Inwood dolomite sufficiently hard so that it was crushed and used again in the concrete lining.

By a peculiar coincidence nearly the same record was being made at the same time on the Montreal tunnel of the Canadian Northern Ry., where an 8x12-ft. heading was driven an average of 26 ft. per day, giving 93 cu.yd. of rock in place removed per day. This heading was driven through Trenton limestone, very similar to the Inwood limestone of New York.

Records of progress in tunnel headings are most often given in terms of lineal feet per day, and on this basis the Loetschberg tunnel in Switzerland with its record average of 32.6 ft. per day holds the world's record. On the same basis the Laramie-Poudre tunnel, where a maximum progress of 21 ft. per day in a heading 7½ ft. by 9½ ft. was made, is credited with the American record.

This basis of comparison, lineal feet per day, is often misleading, and the size of the heading, character of rock, etc., should be taken into consideration in making any comparisons. The Loetschberg heading was only 6½ ft. by 10 ft., and taking volume displaced would only give 79 cu.yd. per day, through soft triassic limestone. The Laramie-Poudre tunnel reduced to volume displaced gives only 56 cu.yd. per day.

It seems to the writer that cubic yards excavated in similar rock, under similar conditions, is the only fair basis upon which to make comparisons. In the Astoria Tunnel, in addition to the regular work connected with the removal of the 100 cu.yd. per day, an average of 96 lin.ft. of deep test-holes had to be drilled each day to prospect ahead for possible trouble, which often delayed the work; and besides this, 126 cu.yd. of rock from the bench were removed over the same tracks, and the whole spoil was raised up a shaft 276 ft. deep for removal.

The maximum progress of full-section tunnel excavation was also 17 lin.ft. per day, with 226 cu.yd. in place excavated.

On the Wallkill Pressure Tunnel of the Catskill Aqueduct, which was driven through Hudson River shale, a record of 17 lin.ft. of completed tunnel excavation per day was made, and this was claimed to be the best progress made to date in the United States on a tunnel of this size in hard rock. Reduced to cubic yards in place this gives 169 cu.yd. excavated per day, against 226 cu.yd. at Astoria. The Laramie-Poudre tunnel also made a regular average of 17 lin.ft. of completed tunnel excavation per day, amounting to 45 cu.yd. of rock in place, the tunnel really being nothing more than a small heading. This was accomplished under conditions of very high wages with a liberal bonus system.

During the six months ending Sept. 1, 1912, the Astoria tunnel was advanced an average of 255 lin.ft. per month. Part of this time was taken up placing the concrete lining, so that the progress stated was made in 19

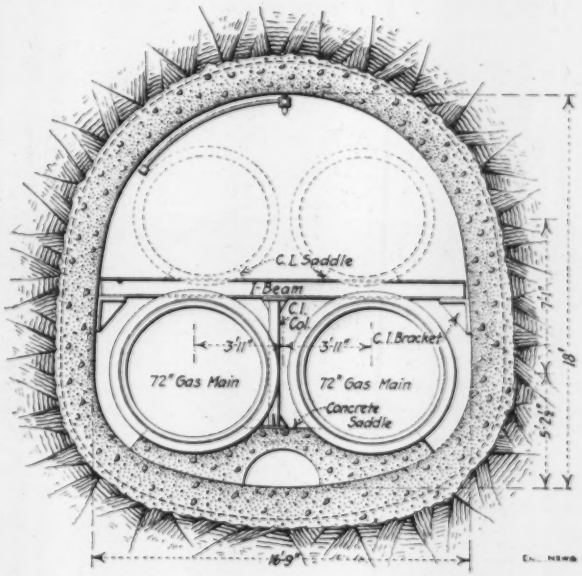


Fig. 3. Cross-Section of Astoria Tunnel, Showing Pair of 72-In. Mains and Future Additional Mains

working days per month, or at the rate of 188 cu.yd. per day, against 169 on the Wallkill tunnel.

## Construction Plant

A very complete construction plant was installed at both ends of the tunnel. In anticipation of possible trouble a much larger boiler plant was installed than would otherwise have been necessary. It consisted of 1200 hp. at the Bronx end and 1800 hp. at the Astoria end, about three times as much as was required to operate the plant outside of pumps. The necessity for such a large installation was afterward proved, as both boiler plants were used to the limit of their capacity in handling the water.

Ingersoll-Rand compressors capable of compressing 3300 cu.ft. of free air per minute were installed at each end for operating drills, pumps, etc., and two 50-kw. generators at each end for lighting the terminal plant and tunnel. Cameron pumps of a capacity of 1000 gal. per min. were installed in the Bronx shaft, and a capacity of 1400 gal. per min. in the Astoria shaft.

Ingersoll-Rand rock-drills were used throughout, the heading being drilled from columns and the bench in the usual way from tripods.

Two muck elevators and one passenger elevator were placed in each shaft. The separate passenger cages, while unusual in such work, were installed for the safety of the men. Every possible precaution and safety device was provided, either included in the original plant or added during the progress of the work.

An emergency hospital with ward capacity of six beds, operating room, kitchen, bath and doctor's room was built especially to take care of accidents on the tunnel work. Orderlies were on duty day and night and a surgeon on call at each end. These precautions resulted in a record of only two deaths since the tunnel was first started, extending over a period of nearly three years, which is believed to be a record on similar work.

FIG. 4. ASTORIA HEADING: ONE OF THE TWO MAIN EMERGENCY BULKHEADS CONSTRUCTED AT EACH END OF TROUBLE ZONE

(Steel drop door, man lock for escape; 3138 ft. from shaft. Looking down slope of inclined platform, toward inner face of bulkhead.)

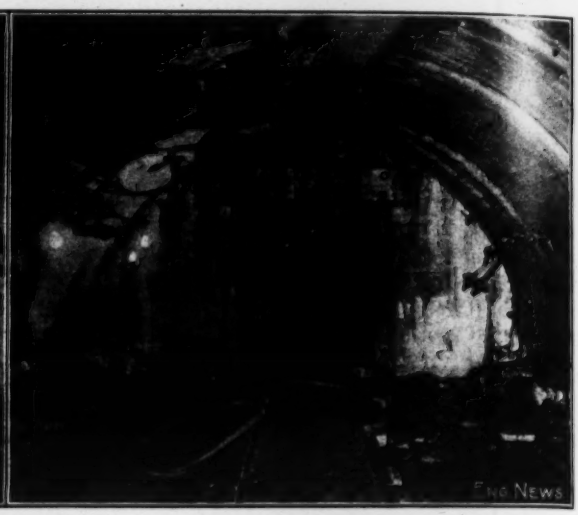


FIG. 5. ONE OF THE EMERGENCY BULKHEADS CONSTRUCTED AT ASTORIA HEADING ON TOP OF THE BENCH TO PROTECT SHORT SECTIONS OF COMPLETED HEADING

(With steel drop door; 3692 ft. from shaft.)

### The Trouble Zone

The first indications of bad ground were encountered at the Bronx end on nearing the westerly gneiss-dolomite contact, the latter part of July, 1911, at a point 700 ft. from the shaft. In the gneiss, small seams of decomposed limestone and some water appeared in the heading. A month later the first water under high pressure appeared in a test hole in the east side of the heading. Holes were drilled and piped, and an attempt was made to force grout into the seams under from 100 to 125 lb. pressure (against a head of about 90 lb.), without success; little grout went in, the pressure employed being apparently insufficient.

On the morning of Aug. 29, 1911, a section of the wall caved in, followed by a heavy flow of green sand (decomposed limestone) and about 1000 gal. of water per minute. This partially flooded the tunnel to the shaft, and, the grade being down toward the heading, the water stood 6 ft. deep at the face of the bench. For a time the pumps just held the water; then a choking of the seam occurred and the flow diminished. A solid concrete bulkhead was built across the heading, with pipes through it to drain the water and to grout thr after the bulkhead had set. An emergency bulk was built 670 ft. from the shaft over the entire tunnel with a manlock for the escape of men the heading and two doorways for cars fitted wit steel doors arranged to trip and drop instantl case of a flood to protect the completed tunnel ar shaft. (Fig. 4 shows a one-door emergency bulkhead. uilt a year later, in the other end of the tunnel.)

During this flood about 1000 cu.yd. of green and mud came in, together with beach sand and shell.

Additional pumps were installed, increasing ca-pacity to 2200 gal per min., and a grouting plant pable of grouting under 200-lb. air pressure was put in. After solidly grouting up the heading behind the bulkhead, a small drift was started through the west side of it to regain the original heading face, which was reached Oct. 9, 1911; but progress regaining the east side of the main heading was extremely slow. After many difficulties, and another heavy flow in the early part of November, when 2000 gal. per min. was pumped and water was 4 ft. deep at the face of the bench, it was decided to run some diamond-drill core borings ahead to determine the extent and location of the trouble. Several 200-ft. holes were drilled. They showed that the trouble extended at least that distance ahead and crossed the line of excavation at an angle so that it would be necessary to cross it with the entire excavation. These holes were completed Dec. 30, 1911.

Widening of the main heading was then resumed. Segmental timbers 10x10 in. were slowly placed back of the concrete lining; steel reinforcing rods were used in the concrete. The main heading reached the previous face on Feb. 9, 1912, and thus five months' delay had been incurred up to this time.

### Discontinuing Bronx Heading Work

Work was continued at the Bronx end under great

difficulty and with very little progress, until Aug. 27, 1913. On that day it was decided to discontinue the heading at this end, on account of difficulty of handling flood water (the drainage of the tunnel being toward the heading) and the greater ease of handling water at the Astoria end.

During the period from August, 1911, to August, 1912, at the Bronx, one year, the heading was advanced 112 ft, a number of large flows of water occurred, and four times the heading was partially flooded. The pumping plant had gradually been increased to 4000 gal. per min. Seven temporary bulkheads had been constructed (either entirely across the heading or across sections of it); 14,679 bags of cement had been used in grouting seams, and 1689 bags in grouting behind bulkheads. During one of the flows of water coal came into the heading, apparently from a coal barge which had sunk in the vicinity, indicating that the connection with the river was probably close at hand, although no indication of air escaping during grouting under 200 lb. pressure could be discovered.

FIG. 6. FORDHAM GNEISS INCLOSED BY INWOOD DOLOMITE ON EACH SIDE; ASTORIA HEADING
(1254 ft. from shaft)

FIG. 7. FLOW FROM BEHIND DAM OF BAGGED CEMENT IN A SIDE DRIFT, ASTORIA HEADING
(Water flowing through two 8-in. and three 6-in. drain pipes. Getting ready to build bulkhead. Maximum flow 6000 gal. per min.; 3655 ft. from shaft.)

### INCREASING ASTORIA PLANT

Preparations were now made at the Astoria end to meet emergency conditions. The pumping plant was increased to a capacity of 6200 gal. per min., and, as the experience at the Bronx end seemed to show that 200 lb. pressure was not sufficient for grouting, a plant was installed at Astoria for grouting under 500 lb. pressure. An emergency bulkhead similar to the one at the Bronx end was installed at a point 3138 ft. from the Astoria shaft with a long settling basin inside of it for catching the mud and sand, and an inclined trackway leading up to the top of the bench. (See Fig. 4.)

### STRIKING TROUBLE AT THE ASTORIA END

On Nov. 6, 1912, at a point 3500 ft. from the shaft, the first serious trouble was encountered when one test-hole gave a flow of 1000 gal. per min. under full pressure. A small drift was started on the east side of the heading, so that holes could be drilled into the seam along the west side of this drift, and grouted, for advancing the main part of the heading. Between this point and the first trouble at the Bronx end there was about 400 ft. of very bad ground along the contact seams which crossed the excavation diagonally from southwest to northeast at an angle of about 35° east of north.

At this point a test of the 500-lb. pressure grouting showed it to be very much more effective than 200-lb. grouting, placing twenty times as much grout in a single test-hole.

### METHODS OF HANDLING THE DIFFICULTIES

From this first entry into the the trouble zone at the Astoria end until the heading was "holed out," on July 17, 1913, progress was made with the greatest difficulty. Large flows of water with mud and sand occurred continually. The general methods used were as follows:

A large number of long test-holes was drilled ahead of any advance. When water was struck in these holes, pipes wrapped in bagging and with valves on the end were driven into the holes with hammers or by drill machines and wedged tight into the rock with steel wedges, bagging and oakum. The mud and sand would then be allowed to drain out of the seams, and thereupon grout would be forced into these holes and allowed to set. Then more holes were drilled and the process repeated, until no water could be located, when a small advance would be made. Where water was expected, large holes were drilled, long enough to place the pipes, then the pipes with valves on the ends would be driven and wedged in as described, and the hole drilled into the water through the pipe, so as to avoid the difficulty of placing pipes against the pressure. Sometimes in spite of this exploration when an advance was started the shooting would seem to start the flow of water, where none had appeared before, resulting in a large flow; in such cases a bulkhead would have to be built, under the greatest difficulties, and the space behind it grouted up and the advance started over again.

When the main heading could not be advanced on account of too bad conditions, side drifts would be run and the seams grouted by means of a great number of holes drilled in the side of the drift.

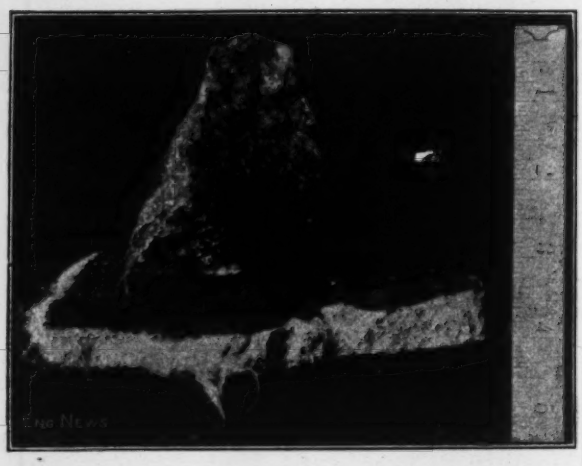

FIG. 8. PIECE OF DOLOMITE WITH GROUTED SEAM
(Grout mixed with waste, and forced in under 500 lb. pressure—white portion.)

GROUT WITH COTTON-WASTE ADDITION—To stop small leaks around pipes and assist in grouting small seams, oats and bran in the grout were tried, following precedent. They did not give success, however. Cotton waste chopped fine and mixed with the grout was finally tried, and proved very effective, so that it was adopted and large quantities of it used. It is believed that this was the first use of waste for this purpose.

HEAVY INFLOW OF WATER—During January and February, 1913, a flow of water which started at 200 gal. per min. suddenly increased, due to a very light shot in the drift some distance away, to 4000 gal. per min. (See Fig. 1, on front page). Three bulkheads had to be constructed, one behind the other (the first two failing in turn), before this flow could be controlled; over 1000 cu.yd. of sand came into the tunnel; 16 ft. of heading and 45 ft. of drift were temporarily lost and had to be grouted solid. From Feb. 7 to Mar. 3, 1913, the average pumpage was over 3000 gal. per min. and the maximum 4400 gal. per min.

FISH FROM THE RIVER—On April 1, 1913, while running a side drift another great flow occurred (Fig. 7), and 25 ft. of drift was lost. A bulkhead was built across the drift. During the next week the average pumpage was 4800 gal. per min. and the maximum 6 gal. per min. For several days live fish came through the leak by the hundreds and were taken home by the workmen.

GROUTING UNDER 500-LB. PRESSURE—This seam was grouted under 500-lb. pressure with 3800 bags of cement, the most successful grouting accomplished at any time during the whole work. During this grouting air bubbles appeared on the surface of the river directly over the line of tunnel and a little north of the heading, being the first such indication of the obvious connection between tunnel and river. When grouting was discontinued the bubbles disappeared.

LESS WATER—As this flood had taxed the capacity of the pumping plant it was increased once more, to 7200 gal. per min. capacity, and forced draft was installed in the boilers. The heading was then continued, through the worst ground yet encountered, but only one heavy flow of water (2400 gal. per min.) occurred, the last grouting evidently having shut off the main supply.

From this point on considerable quantities of grout in seams of the rock appeared in the heading, for the first time, as previously the grout had seemed to go outside the excavation line. Seams of green sand and rotten rock as wide as 5 ft. were encountered, and at times the entire face of the heading was a mass of sand and rotten rock so that it could be largely removed with a pick, and much of it could be pulled out with the hand.

A CAVITY IN THE ROCK—At one point an empty pocket 10 ft. wide, 8 ft. high and 10 ft. deep, with another hole running off from it along the contact between gneiss and limestone 4 ft. high, 8 ft. wide, and 8 ft. deep, was encountered. This great cavity had probably been washed empty during one of the floods of water and mud.

Three additional emergency bulkheads with drop doors (see Fig. 5) were built across the heading to protect

FIG. 9. ASTORIA HEADING DRIFT HOLED THROUGH TO THE BRONX HEADING
(July 17, 1913; 3741.7 ft. from Astoria shaft.)

FIG. 10. A COMPLETED SECTION OF ASTORIA TUNNEL
(Bronx end; with construction tracks on the invert. Concrete saddles for pipes not yet placed.)

short stretches of completed heading, and 22 temporary bulkheads across the main heading or across corners of it were constructed at the Astoria end to control the water.

Amount of Grouting Done—In all, the work in the Astoria end consumed 14,414 bags of cement in grouting seams, and 5550 bags in grouting behind bulkheads. Adding to this the amount which had been used in the Bronx end makes a total at both ends for seams of 29,093 bags and behind bulkheads of 7239 bags, or a grand total of 36,332 bags or 9083 barrels used merely for grouting seams and bulkheads.

### The Tunnel Holed Through

The heading was "holed out" on July 17, 1913, at 3:35 p.m. The last shot was fired by George B.

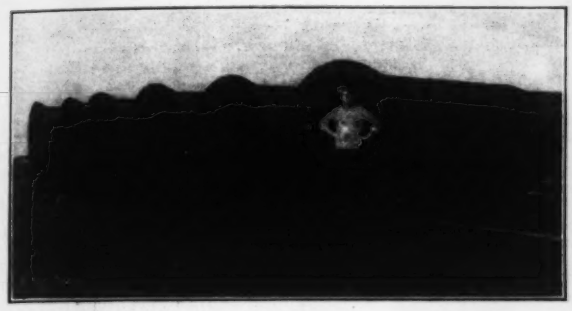

Fig. 11. The 72-In. Gas Mains, the Largest in the World, Which Are to Be Installed in the Astoria Tunnel

Cortelyou, President, and Wm. H. Bradley, Chief Engineer, of the Consolidated Gas Co.

### High-Pressure Grouting

Grouting with high-pressure air was developed on this work beyond anything ever before attempted. The highest air pressure previously used for this purpose was used on the Rondout Pressure Tunnel of the Catskill Aqueduct, where a pressure of 300 lb. was used, as compared with 500 lb. at Astoria. Hydraulic grouting has been done to a small extent with greater pressure. The largest hydraulic pressure used for this purpose was on the Hudson River Siphon of the Aqueduct where 1000 lb. pressure was used, the leak, however, only amounting to 150 gal. per min. A pump was used in that case because air compressors for that pressure could not be secured.

### Difficulties Overcome

It is believed that greater difficulties were encountered and overcome in the 400-ft. trouble section of the Astoria Tunnel than on any other similar work. Probably the nearest approach to the water conditions, considering those cases in which tunnels were carried through the trouble rather than around it, was on the Rondout Siphon mentioned above, where the greatest flow of water encountered was 2000 gal. per min. under 85-lb. head; this is to be compared with a maximum flow of 6000 gal. per min. under 90-lb. head at Astoria.

### Alignment

The alignment of the tunnel checked within ¾ in. and the grade within ⅜ in.

### Gas Mains

Two 72-in. (inside diameter) cast-iron gas mains will be laid at present and two more mains later when needed. The mains are made up of sections 12 ft. long and 2½-in. thickness of wall, and each section weighs 13 tons. They will be the largest gas mains in the world. The pipes will be supported on 771 concrete saddles, each weighing over a ton. The joints will be calked with lead wool by means of a special pneumatic calking machine operated from the top of the pipe.

It will take about one year to finish excavating and lining the tunnel and laying the gas mains.

### Organization

The entire work of engineering, organization and construction is being carried on by the Consolidated Gas Co., of New York, through its subsidiary, the Astoria Light, Heat & Power Co., under the direction of William H. Bradley, Chief Engineer; W. Cullen Morris, Engineer of Construction; and Harold Carpenter, Resident Engineer; by Jacobs & Davies, Inc., Consulting Engineers, who engineered the Pennsylvania R.R. Hudson River tunnels, the Hudson & Manhattan Ry. tunnels and other similar work in other parts of the world. Mr. Vivian Messiter, Engineers' Agent, is in charge for Jacobs & Davies.

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**A Steel Chimney** to increase the height of an existing brick chimney has been put in place on the Borland Building, Chicago (at Federal and Harrison Sts.) The steel extension is about 100 ft. high and 9 ft. diameter. It was raised in one piece to the top of the building and set in place on the brick chimney by a derrick having a spliced beam about 140 ft. long.

**Locomotive No. 40,000** built by the Baldwin Locomotive Works was completed recently, being an engine of the 4 : 6 : 2 class for fast and heavy passenger service on the Pennsylvania R.R. The first locomotive built by this firm was completed in 1832, and its No. 1000 in 1861, No. 5000 in 1880, No. 10,000 in 1889, No. 20,000 in 1902 and No. 30,000 in 1907. The first locomotives were built at a small shop in Lodge Alley, Philadelphia, but in 1835 a shop was built on the site of the present plant at Broad St., which plant now covers over 17 acres and has 38 buildings with 38½ acres of floor space. As this plant could not be further enlarged, a site for a new plant at Eddystone, Penn. (12 miles from Philadelphia) was purchased in 1906. This has an area of 225 acres, and extensive shops have been built upon it, with about 30 acres of floor space. A site of 370 acres for works at East Chicago, Ind., was purchased in 1911, but no locomotive shops have yet been built; a plant for making steel tires and wheels has been established on this site by the Standard Steel Works Co., in which the Baldwin firm owns a controlling interest. The Baldwin Locomotive Works now employ about 1900 men and can build about 2500 locomotives per year.

Engine No. 40,000 is one of an order for 30 engines, and is equipped with Belpaire firebox, Walschaerts valve gear, Schmidt superheater and Crawford underfeed mechanical stoker. The general dimensions are as follows:

| | |
|---|---|
| Driving wheels | 6 ft. 8 in. |
| Truck wheels | 3 ft. 0 in. |
| Trailing wheels | 4 ft. 8 in. |
| Wheelbase, driving | 13 ft. 10 in. |
| Wheelbase, engine | 35 ft. 2 in. |
| Wheelbase, engine and tender | 60 ft. 2 in. |
| Weight on driving wheels | 189,500 lb. |
| Weight on leading truck | 46,100 lb. |
| Weight on trailing truck | 57,600 lb. |
| Weight of engine | 293,200 lb. |
| Weight of engine and tender | 475,000 lb. |
| Cylinders | 26x26 in. |
| Boiler, straight top, diameter | 6 ft. 8 in. |
| Working pressure | 205 lb. |
| Firebox | 9 ft. 2 in. x 6 ft. 0 in. |
| Tubes, steel, length | 21 ft. 0 in. |
| Tubes, No. and diameter | 32, 5½ in.; 202, 2¼ in. |
| Heating surface, tubes | 3453 sq. ft. |
| Heating surface, firebox | 204 sq. ft. |
| Heating surface, arch tubes | 23 sq. ft. |
| Heating surface, total | 3680 sq. ft. |
| Superheating surface | 845 sq. ft. |
| Grate surface | 55¼ sq. ft. |
| Coal on tender | 24,600 lb. |
| Water on tender | 8000 gal. |

# The Adjustment of the Devices at Hinge, Miter Ends and Sills of Panama Canal Lock Gates to Prevent Leakage

The Panama Canal lock gates are the largest and most massive hinge gates ever constructed, and their design, erection and adjustment presented many unique engineering problems. The design of these gates was described in an article in our issue of Sept. 16, 1909, which

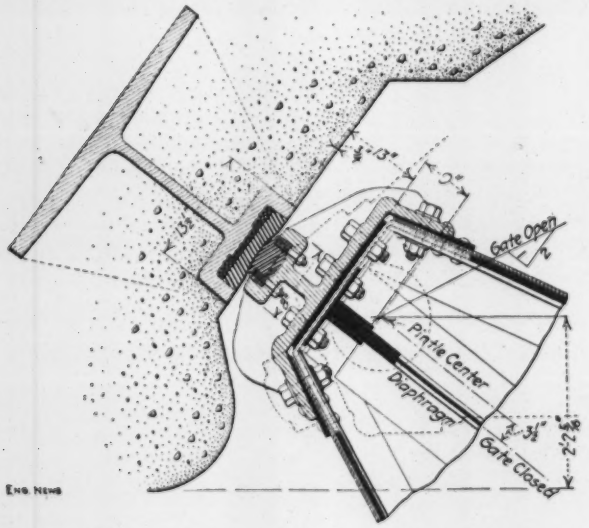



FIG. 1. DETAILS OF THE MITERING DEVICE AT HINGE OF PANAMA CANAL LOCK GATES

gave in some detail the proposed methods of insuring watertight joints. The following article, reprinted with some slight changes from the "Canal Record" of Aug. 6, 1913, shows how the design was executed and how well every detail fulfilled the purpose of its design.

The detail work of preparing the design of the gates was carried out under the direction of Henry Goldmark, Designing Engineer; and the construction and erection of the structural steel of the gate leaves was done under the supervision of L. L. Jewell, Manager of Erection for the contractor, the McClintic-Marshall Construction Co., of Pittsburgh, Penn., until September, 1912, and since then under the supervision of W. M. Sterrett, the successor of Mr. Jewell, who resigned to become President and Chief Engineer of the Central American Construction Co.

On June 14, the lower guard gates at the Gatun locks, Panama Canal, were closed and water let into the forebay, which had separated the sections of the channel, to the full height to which the gate leaves will be subjected when the canal is in operation. As the water began to rise against the outer faces of the gates, they showed only slight leakage, and the pressure of the full head of 42 ft. of water forced the mitering leaves so closely together that the slight initial leakage soon ceased. These gates may be said to be practically watertight.

Each of the four leaves of these gates is 65 ft. long, 7 ft. thick, 47 ft. 4 in. high, and weighs 390 tons.

Throughout their construction, special care was taken to perfect their alignment and make them fit exactly. A special machine was installed at the works of the contractor in the United States, by which both ends of the horizontal girders were planed at the same time. This machine remained unchanged until all the girders were completed.

As the skeletons of the leaves were erected in the locks their alignment was constantly checked with fine steel wires; it is believed that their greatest deviation from a pl line does not exceed ½ in. for any of the leaves, even be the end castings are attached and the bearing plates adj

At the top of every fourth panel from the bottom ust- able fillers were set between the vertical diaphragms the girders above, in order to keep companion leaves at t me height; the heights of all completed gates agree with in.

The stiffness of the leaves is so great that the total lec- tion at the bottom has never exceeded ¼ in., when the ves were set on pintle and anchors, and swung repeatedly t ugh full movements, without the buoying force of the wa by which the stresses will be lessened when the gates in actual operation.

The careful construction and erection of the str ural steel made possible a very exact adjustment of the kel steel bearing plates along the vertical ends of the leav In- deed the closeness of the joints between the two leaves the mitering ends, and with the fixed castings at the hinge nds, is regarded as unprecedented in large scale steel con ruc- tion.

The adjustment at the hinge or quoin ends of the l aves is indicated in the accompanying Fig. 1. The heavy steel castings (shown in light cross hatching) were embedded in the lock walls as they were built.

These castings contained machined recesses at the end toward the lock chamber; the bearing plates of the hollow quoins (shown in dark hatching) were set in the recess and attached to the castings by 1-in. bolts, spaced 17 in. apart, while temporary stud bolts were placed at intervals of about 2 ft. along the center line of the plates to assist in the adjustment.

The exact center of the bearing plate was determined by a plumb line placed directly over the center of the steel pintle on which the bottom of the leaf was later to be placed.

After the plates were so exactly aligned that the deviation from exact correctness nowhere exceeded 0.005 in., melted babbitt metal was poured into the space between the bearing plates and the heavy steel castings embedded in the wall. The babbitt metal was poured through bolt holes about 4 ft. apart, vertically. To avoid explosions from dampness and insure exact filling, hot compressed air was first blown into the space. Finally, the joints between the bearing plates and the steel castings were calked.

Corresponding bearings were provided in the end of the gate leaf. Heavy steel castings (shown in light hatching in Fig. 1), with recesses at the outer ends were securely riveted to the leaf, and to these bearing plates were attached by means of bolts. The gate leaf was then set on the pintle, as for operation, and swung to its closed position. The bearing plates on the leaf were forced closely against the fixed bearing plates in the wall castings, and held by means of adustable bolts. The leaf was then swung into open position, exposing the faces of the bearing plates, and the latter were babbitted in the manner used for the fixed quoin plates, as already described.

These adjustments were always made early in the morning, to insure a uniform temperature throughout the leaf. It was expected originally to adjust the plates at the outer or

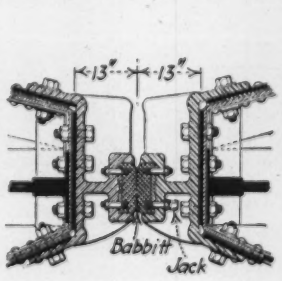



FIG. 2. MITER ENDS OF LOCK GATES

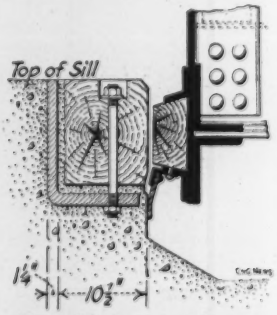



FIG. 3. SILL OF LOCK GATES (Showing Device for Watertight Joint.)

miter ends of the leaves in the same way, by bringing the two leaves of a gate to correct closed position and pressing the bearing plates against each other by means of jacks. However, the variations in the lengths of leaves from temperature changes, even within short periods, made it necessary to use another method.

In this adjustment the leaves are closed and the plates at top and bottom are brought into contact and fixed in their proper position. The leaves are then swung apart and the

remaining plates adjusted in correct alignment, as determined by means of a fine wire plumb line, with those at top and bottom. After the babbitting, the leaves are brought together again, and any small irregularities are corrected by grinding the surfaces of the bearing plates. A section of the adjusted plates of the two miter ends, in closed position, is shown in Fig. 2.

Leakage at the bottoms of the leaves has been obviated by the use of a specially designed sill, using a rubber strip along the line of contact. (Described in "Engineering News" of Aug. 8, 1912, p. 243.) A cross-section of the sill, with the leaf closed against it, is shown in Fig. 3.

As shown, a heavy timber is set in the concrete of the lock floor; this timber is not adjusted until after the quoin and miter bearings have been completely finished and the smaller timber attached to the leaf. The timbers having been adjusted, a strip of rubber, 5 in. wide and ½ in. thick, is attached to the leaf by means of an angle which is fastened to the plate below the timber cushion. The strip serves to prevent the escape of water between leaf and sill, even when for any reason the timbers are not in absolute contact. This construction is novel and has proved to be effective.

## A Gasoline Freight Locomotive

A recent interesting development of the railway-motor car is a gasoline motor freight and switching locomotive, which has been put in service for yard work and road work on the Minneapolis & Northern Ry., is an 18-mile line extending from Minneapolis to Anoka, Minn., operated entirely by motor cars. The freight locomotive was built by the McKeen Motor Car Co., of Omaha, Neb., and its power equipment is practically identical with that of the McKeen passenger motor cars which are used on this road and are used also for auxiliary service on a large number of steam railways in this country and abroad.

The new freight locomotive, which is shown in the accompanying cut, is a four-wheel machine, with one axle driven directly from the gasoline engine, and with coupling chains (instead of rods) for driving the other axle. In the double-track passenger cars (described in ENGINEERING NEWS, Jan. 20, 1910), only one axle of the motor truck is driven, and this axle has larger wheels than those of the rear axle of the truck. The locomotive is 17 ft. long over the couplers, and 14 ft. over the end sills, with a width of 9 ft. 6 in., and a height of 12 ft. 3 in. over the radiators on the roof. The weight of 43,000 lb. is carried on four 42-in. wheels with a wheelbase of 6 ft. 6 in. The truck frames are of cast-steel, and the brake and coupler equipment conform to the M. C. B. standards. The machine carries 120 gal. of gasoline and 170 gal. of water, the former supply being sufficient for 10 hours of ordinary service. Larger tanks can be fitted if required. There are two speeds, 8 and 22 m.p.h., and the machine can haul 20 loaded freight cars on level track.

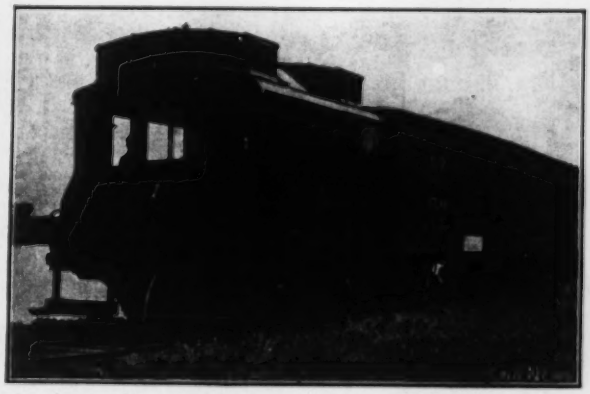
The power equipment is a six-cylinder vertical, reversible, variable-speed gasoline engine of 200 hp., having cylinders 10x12 in. The engine has an inclosed crankcase, inclosed herringbone gears, a water cooling system and a compressed-air starting device. The cooling system comprises two radiators mounted on the roof, and a geared pump driven from the engine crankshaft by a Morse silent chain. The engine is set transversely, about midlength of the machine, with the ends of its bed resting on the cast-steel side frames.

The crankshaft is in two pieces, connected at the middle by a combined coupling and sprocket wheel, from which wheel a 5-in. Morse driving chain of 2-in. pitch runs to a large sprocket wheel carried by a sleeve rotating freely upon the front axle. This second sprocket wheel is attached to the outer or driving member of a multiple-disk friction clutch of heavy construction, having 2200 sq.in. of available surface. This member of the friction clutch can be connected either directly to the axle or to a set of back gears (of the herringbone type) by means of a sliding clutch. Both clutches are operated and controlled by means of compressed-air cylinders.

In starting a train, the high torque required is secured by transmitting the power from the axle sprocket wheel through the sliding clutch and back gears to the axle. When the locomotive has been started, the sliding clutch is shifted so as to disengage the back gears and connect the axle sprocket directly to the axle. With this direct-drive position, the sprocket, clutch and axle rotate as one unit, and the only loss of power in transmission is that through the driving chain, which is 3 to 4%. On each end of the driving axle is a sprocket for a 4-in. coupling chain of 1½-in. pitch, which drives the rear axle through a similar sprocket.

The carburetor is of special design, capable of using low-grade gasolines and distillates. It has special features for insuring the proper mixtures suitable for cold and hot days. The exhaust from the engine is carried through a muffler and discharged through a stack which extends above the roof.

Compressed air is used for starting and reversing the engine, operating the control and clutches, and operating the brakes and whistle. An ample and constant supply of compressed air is necessary, therefore, and two sources of supply are provided. An air pump 5x4 in. is mounted on the engine bed and driven from an eccentric on the crankshaft, and there is an independent compressor driven by a small gasoline motor. Only one man is required to handle the engine. It seems probable that such



GASOLINE FREIGHT AND SWITCHING LOCOMOTIVE OF THE MINNEAPOLIS & NORTHERN RY.
(McKeen Motor Car Co., Omaha, Neb., Builder.)

an engine could be employed to advantage for switching service in the yards of steam railways.

It is of interest to note also that in one case a construction locomotive was improvised by taking the motor truck from a McKeen passenger motor car and building a suitable deck and housing or cab upon it. This was used for handling rails, ties, etc., during the construction of the Charles City Western Ry., in 1911, and is said to have effected a considerable saving as compared with a steam locomotive for such work.

# Motor Inspection and Maintenance in Industrial Plants

By F. E. Hanchette*

In large industrial plants where motors are extensively and in many instances exclusively, used for driving the machinery, it is a matter of the utmost importance that such motors shall receive careful attention to prevent the possibility of a stoppage of work on any machine by reason of the electrical equipment going wrong. A large percentage of time lost through this cause can be eliminated by instituting a system of daily inspection of each motor, thereby insuring continuity of service and also a saving in the maintenance cost of the motors and shop equipment.

In most plants using a large number of motors, some sort of an inspection is maintained, but in few instances carried to a point where it is either thorough or efficient, although often costing more than would a systematic inspection.

Many times trouble has developed in a motor only because the man who should have given it his attention, did not do so and thus overlooked the first signs of trouble and remedying it before it developed to serious proportions. Such a man, to cover his negligence, often makes it appear that the fault was in the motor or due to improper handling by the operative. In a majority of ca- his explanation is accepted unquestioned, especially if his foreman considers him a competent and reliable work-man, while the operative or the apparatus is unjustly blamed.

A regular daily inspection of every motor in a plant, no matter how many there may be, is easily accomplished economically and efficiently. To some, before the system about to be outlined has been given careful consideration, it may seem too much like red tape, but it has been demonstrated that such a systematic inspection positively reduces the maintenance cost of the plant. It also increases

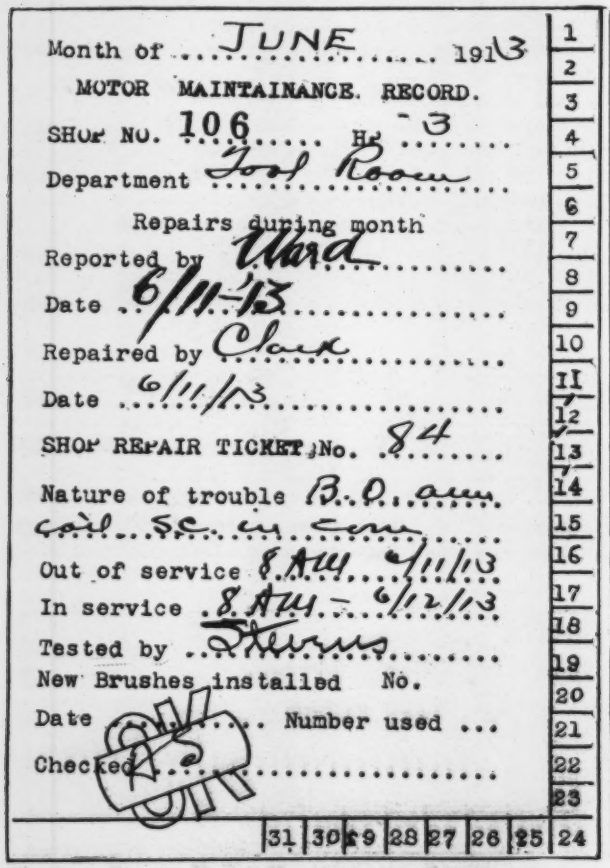

Month of JUNE 1913
MOTOR MAINTAINANCE. RECORD.
SHop No. 106 Hp 3
Department Tool Room
Repairs during month
Reported by Ward
Date 6/11/13
Repaired by Clark
Date 6/11/13
SHOP REPAIR TICKET No. 84
Nature of trouble B.O. arm. coil. S.C. in com
Out of service 8 AM. 6/11/13
In service 8 AM. 6/12/13
Tested by Stevens
New Brushes installed No.
Date Number used
Checked
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
31 30 29 28 27 26 25 24

Fig. 1. Motor Maintenance Record

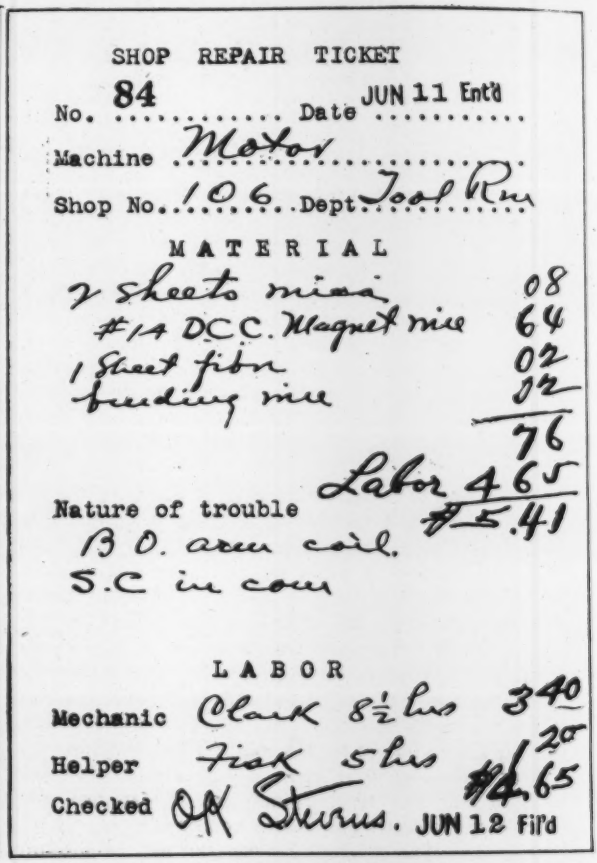



Fig. 2. Shop Repair Ticket

In most plants the driving motors are worked well up to their capacity (in some cases beyond that point) and upon their performance depends the daily output; each motor should be inspected daily for any showing of defects, loose connections, keeping the brush tension normal, oiling devices operating freely, the motor free from dust and dirt and the commutator free from oil which would soon penetrate the mica insulation and carbonize. The starting and the speed-controlling devices should also be given attention and all sliding contacts kept free from burrs or burns and must make proper contact.

To do this, allowing but a few minutes at each motor, and to have positive evidence that each motor is actually visited, a card form has been developed as shown in Fig.

the output by eliminating delays caused by defective electrical equipment, conserves the temper of the machine operative and increases his efficiency.

*Chief Electrical Inspector, Operating Department, Edison Electric Illuminating Co. of Brooklyn.

having the numbers from 1 to 31 printed along one side and the bottom, to correspond to the days of the month. A card holder of tin, with the edges of the sides and bottom turned over to hold the card, is placed on or near each motor; several ticket punches, each having a different design, are required, one for each inspector.

MOTOR SHOP No. 106 SERIAL
DEPT. Tool Room.
Make G.E. HP. 3 RPM. 1250
Volts 220 Amp. 11 Type. C E Cl. or Form. A
Size of brush 5/16 x 1 1/4 x 2 1/8 Stock No. 39
Number brush studs 2 Per stud 2
Date received NOV 12 1911 Cost
Date in service JAN - 5 1912 Dept. Tool Room
Machine Crank Shaper Shop No. 54
Starter C-H Bul. 10
Out of service
Disposition

FIG. 3. MOTOR INDEX CARD

Each morning as they start on their rounds the foreman distributes these punches, changing them each day to prevent the skipping of a motor one day and the punching of the card the next day. It is also well to change the routes of inspectors, not only to prevent possible collusion, but to better familiarize all of the men with the entire factory equipment. The punch mark of each man for any certain day will appear on the motor-inspection card on that date for each motor that he visits, and on his time card for that date also. This gives an absolute check on the movements of each man for every day he is on inspection duty.

These cards are arranged for one month each, numbered according to the "shop number" of each motor, the cards being turned in on the last day of each month and new cards placed in the holders on the trip made the following day; each card contains the complete record of that motor bearing the same shop number. If repairs are needed, the inspector so notes on the card and immediately informs the foreman who assigns a repair man to do the necessary work.

Should it be necessary to stop the motor, the time of stoppage is noted on the card together with a brief statement of the cause of the trouble. If material is required for the job, he makes out a "Shop Repair Ticket" (Fig. 2), which also serves as an order for the material at the storeroom. The total time spent on the job is noted on the ticket, which is turned in to the storekeeper at the completion of the work and the prices of all material used filled in and the ticket placed in the "Inspection Box." The ticket is removed from the box by the foreman or assistant, the work inspected and tested and the card returned to the foreman's desk, where items and time are checked and entered and the card filed, after the repair costs also have been entered on the back of the "Motor Index Card" (Fig. 3).

With these three forms, used in conjunction with the workman's daily time sheet such as is commonly used in all industrial plants, an absolutely accurate record is instantly available for reference and at the end of each quarter or year, the maintenance costs for the period can quickly be figured.

The motor-index card contains all data pertaining to the motor bearing that "Shop Number," each motor being assigned a number which is painted or stenciled on the frame as soon as received and a card filed in the index to correspond. These forms are printed on standard 3x5-in. cards and filed in numerical order, or by departments as desired. The shop-repair ticket forms are printed on 4x6-in. manilla cards as are the "Motor Maintenance Records," the former also being used for repairs to any machine or other shop equipment in the plant and filed according to number in a separate filing box under "Shop Equipment."

Brushes and brush troubles are a large factor in smooth operation; when new brushes are placed on a motor, the old ones should be turned in to the storekeeper, not necessarily for further use, but as evidence that new ones were actually required. In some cases the unused portion can be cut down for smaller motors, thus effecting a saving.

Care in the selection of brushes should be exercised, and it will be found cheapest in the end to buy the best brush obtainable, as cheap grades of carbon brushes usually contain more or less grit which is bound to cut

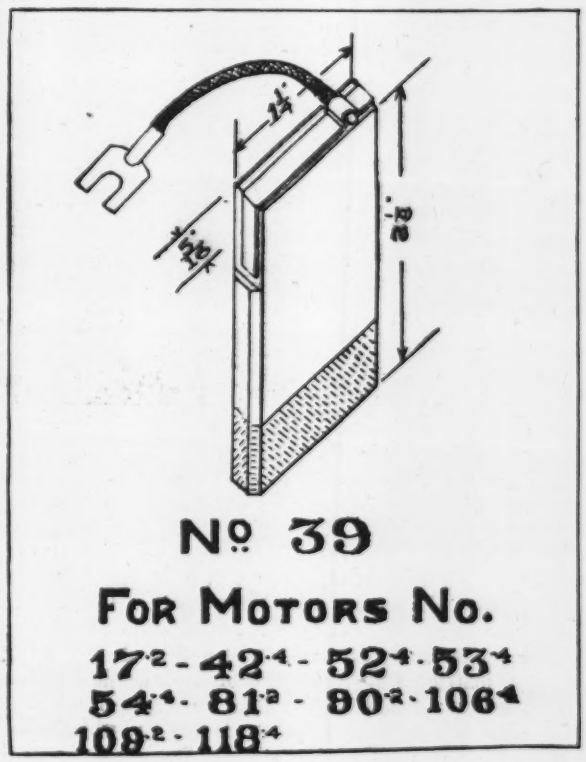



FIG. 4. PRINT OF THE BRUSH REQUIRED FOR CERTAIN MOTORS

the commutators and prevent their acquiring a glazed surface, as they should under proper selection and care. Brushes should be standardized and each separate size used given a "Stock Number" and prints made showing in exact sizes, all brushes used. These prints will not only be found to be a great aid in keeping down mistakes in the shop, but when a new supply is required, a print of

the brush with the order insures the receipt of the proper brush. Upon each print, under the stock number, should appear, "For motors No. ....., followed by the shop number of each motor requiring that particular brush (Fig. 4). The small figure to the right of each motor number, is the number of brushes required for that motor.

Should there be any question regarding the exact brush required on any motor, reference to the brush prints quickly disposes of the matter. This system is also applicable to those firms who carry on a motor-inspection and maintenance business, by merely substituting "Firm" or "Location" in place of "Department" on the cards. Electrotype plates of the forms can be procured at a low cost and will reduce the printing bills to a considerable extent. The system has proven beyond any doubt that it is a time-, labor- and money-saving proposition.

## The South San Joaquin Irrigation Project, California

A large irrigation project was put under construction in 1911 by the South San Joaquin Irrigation District, California. Edwin Duryea, Jr., of San Francisco, is chief engineer for the district and to him we are indebted for the following outline of the nature and present status of the project.

The district comprises 71,050 acres of nearly level land, of a sandy-loam character and practically all irrigable under the system now being built. About 3000 acres of this area have been irrigated for some years.

The water-supply of this district and of the adjoining Oakdale district is the entire flow of the Stanislaus River. The water is taken from the river by means of a diversion dam and headworks (Figs. 1 and 2), which were completed early in December, 1912. The diversion dam is of a pure arch type, with two 135-ft. radius spans abutting on a central pier, making a total crest length of 166 ft. The maximum height of the dam is 78 ft., or 70 ft. above the intersection of its lower side with bedrock. The maximum thickness is 16 ft. at the point just named, which is at Elev. 280 ft. From here until downstream low water (Elev. 289) is reached (which will be maintained by a low dam a little ways below the main dam) the thickness diminishes rapidly to 12 ft., then slowly to 8 ft. at Elev. 325 ft. (high water of Jan. 31, 1911; but in March, 1907, high water was at Elev. 334 ft.). For the remainder of the height the dam is perpendicular on each face and 8 ft. thick, except that in the upper 3 ft. there is an overhang on the downstream side and the upstream side is chamfered off. The crest is at Elev. 350. The structure is known as the Goodwin Dam.

The headworks consist of a double set of cast-iron gates in concrete regulating works.

The main canal has a length of 19 miles, with shapes and sizes depending on the character of rock, the surface slopes and the ability of the material to resist erosion. About 3½ miles of the main canal were entirely completed by the end of March, 1913. The remaining 15 miles are now practically completed, and on Aug. 13 water through the main canal arrived at the upper edge of the Irrigation District.

The distribution system has been very carefully designed so as to deliver a head of 16⅔ cu.ft. per sec. at the high point of every Government 40 acres within the District. When completed it will comprise about 360 miles of irrigation canals and ditches and some 35 miles of drainage canals. The contract for the main distributary canal, 12 miles in length, is now under way and nearly completed and a contract for about 20 concrete structures (headworks for branch canals, etc.) along it is in progress. Contracts for all of the remainder of the 360 miles of canals and ditches are also under way, and a contract has been let for about 2,500,000 ft. b.m. of lumber for the wooden structures along them.

FIG. 1. VIEW FROM BELOW

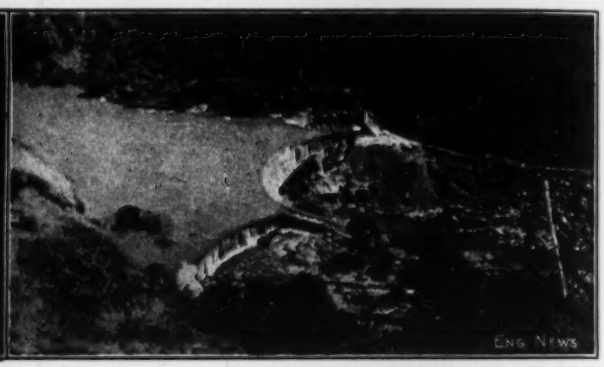



FIG. 2. LOOKING ACROSS DAM FROM NORTH END

FIGS. 1 AND 2. GOODWIN DIVERSION DAM, SOUTH SAN JOAQUIN IRRIGATION DISTRICT, CALIFORNIA

A storage reservoir is to be situated about seven miles east of the east edge of the District. It will be formed by inclosing a small foothill valley with a dam about three miles long and filled by the supply canal that enters the upper end of the valley. A capacity of 49,000 acre-feet is proposed for the present, to be later increased by raising the dam 15 ft., developing in all 101,000 acre-feet. If desired in the future, a second dam (several miles above) will increase the total storage to 134,000 acre-feet.

The total cost of the system will be about $3,835,000 in irrigation-district bonds, or at the rate of $54 in bonds per acre. Of this the diversion dam and headworks and the supply system will have cost about $27 per acre, the distribution system about $16 per acre and the reservoir storage (for 49,000 acre-feet) about $11 per acre.

The total cost given above is now about half expended and the work of completing the system is being carried along as rapidly as practicable, so that it may be completed (except the storage reservoir) by April, 1914.

# The Brick Roads of Cuyahoga Co., Ohio*

By James M. McCleary†

*SYNOPSIS—The brick-paved country roads which have been built during the past five years in the territory surrounding Cleveland, Ohio, especially in Cuyahoga County, have received high praise from engineers and road builders; but in many cases where brick pavement has been adopted for roads and streets in other localities, nothing like as good a road has been secured. The following paper by the engineer in charge of the construction on these famous brick roads makes clear that success depends on faithful care in a number of small details of construction. It may be difficult for an engineer to induce the average street-paving contractor inexperienced in brick paving to work in this painstaking way; but the Cleveland results show that it is just this care and skill, which is essential to success. Mr. McCleary's paper deserves the careful study of every engineer interested in road and pavement construction.*

The road system of Cuyahoga County has received so much praise that anyone who claims connection with its development incurs danger of the charge of egotism, provided he omits to point out that the much heralded excellence was a gradual growth and that costly mistakes marred the county's early ventures into this realm of improvement. These mistakes were less due to wrong theories or practices of the engineers than to the demand of the taxpayer for a cheap improvement.

I shall deal with the mistakes of early brick construction, for it was by these earlier experiences that the present methods of building brick roads in Cuyahoga County were evolved. No peculiarities of topography or soil make this kind of road more appropriate in Cuyahoga County than elsewhere. In the western part of the county the land is so level that drainage is a difficult problem and must be given much consideration. In the southern and eastern parts, the land is so broken that to secure a feasible grade without undue expense for excavation becomes the chief difficulty. The soil varies from a sticky yellow clay in the southern and eastern sections to a sandy loam at the west. The development of the brick road in Cuyahoga County, therefore, was obstructed by all the possible problems to be found elsewhere.

The first brick road in Cuyahoga County was started in 1893 and completed in 1895 and located on what is known as the Wooster Pike in the southwest portion of the county. The wearing surface was of standard size brick, 8 ft. in width, tar filled, placed between stone curbs, 3x15 in. and resting upon a 6-in. broken stone base. The pavement was placed upon one side of the roadway with a graded earth drive occupying the balance of the width. No drainage was provided and really nothing of detail was taken into consideration. The specifications were principally contained in the title on the back of their cover. So far as the contract was concerned, it provided chiefly that the contractor was to be paid in any event. If anything could open the eyes of blind justice, surely it would be this first contract awarded in Cuyahoga County for brick pavement.

No requirement in the specification dealt with the quality of the stone and the result was that the contractor gathered up field stone for his base and they were of such consistency that, when the roller had done its work, one might think that sand ballast had been used. Upon this the cushion was placed without compression and then the brick. As to the filler, no one could have told its composition at the end of six years, so little of it could be found.

The pavement being but 8 ft. in width, all of the traffic came in one place. Lack of bond and absence of uniform support caused a depression to appear. In the wet season, this rut or groove filled with water which soaked through the base, creating a worse condition from day to day during the damp seasons. The colder weather brought upheavals and such havoc that many sections of the improvement (so called) were a hindrance rather than an aid to the traffic.

I anticipate your query as to why these defects were not repaired. Strange as it may seem, the law under which these improvements were made permitted no expenditure for maintenance. In 1898 this legislative flaw was remedied, but for five years there was no chance to palliate the badness of our methods nor to interfere with the increasing dilapidation which constituted the chief value of this road—the value of a horrible example.

The next road laid was South Woodland. Again the wearing surface was 8 ft. in width, tar filled and placed between flush stone curbs on a 6-in. broken stone base. We had learned, in a small way, from our first mistakes and placed a 6-in. drainage tile beneath the center of the roadway. But on account of the soft filler and imperfect preparation for carrying off the water, but little improvement in the result was realized. An uneven settlement of the base soon resulted in roughness. For all of its shortcomings, however, I wish to state that when it was taken up three years ago to be replaced by a 30-ft. roadway, its condition was such that by contrast, not every town or county could point a finger of scorn at it.

Lorain Road, our next installation, was built 16 feet wide, tar filled and resting upon a crushed stone and slag base between flush curbs, with drain tile beneath each curb. Subjected to an unusually heavy traffic, the almost inevitable result of such construction must be extensive repairs amounting almost to reconstruction.

Our next great forward step occurred when the tar filler gave way to a grout filler composed of one part sand and one part cement. This plan was followed until 1905 with success, at least in comparison with previous experiences. The cement filler alone, however, could not cure all of the defects due to inferior drainage and frost action. Another step was therefore decided upon, the inclusion in the specifications of a requirement for a 4-in. concrete foundation which, of course, increased the price. State Road No. 2 was constructed under this plan, the increased cost brought immediate opposition, resulting in a temporary return to a broken stone or slag base until 1908 when concrete was again adopted as a foundation and has continued up to the present time.

Since 1908 it has been the policy not merely to conform to the chief essentials of brick paving, namely,

The properly prepared subfoundation,
The smoothly finished concrete base,
The compressed sand cushion,
The laying of good brick,

The application of the cement filler to the joints, but to attach importance to minor details of approved manner and method of construction as will produce a road nearly approaching the ideal. Our approach to the ideal has given to us roads which have received almost a world wide commendation and have given to Cuyahoga County the best road improved district of any like sized area in the world.

A satisfactory plan for an average rural pavement may include a paved portion anywhere from 9 to 16 ft. in width, the width being controlled by the amount of traffic to which the road is subjected. A dirt or gravel macadam should occupy the balance or unpaved portion of width. Whatever dimensions are adopted, the surface drainage should be over the pavement toward a ditch on the side of the road closest to the pavement, eliminating a crown from the paved portion. The unpaved portion should be drained in the opposite direction.

Immediately you ask "Why a dirt road?" The best answer is, "Ask the farmer" and he will tell you to ask the horse.

The engineer will save himself much trouble if he holds to such a grade line as will entail minimum depths of fill. This is not always possible and it is the larger fills that call for the most extreme care. It behooves the engineer to see that his specifications contain a clause calling for the fill to be put in layers of not more than 6 in. thickness and each layer compacted with a roller, not exceeding ten tons in weight. This clause must be enforced with rigidity.

Puddling is the one method that can be followed successfully in the treatment of old fills. The surface of the road should be broken and dirt removed from the center to the sides. At right angles to this trench, shorter trenches should be dug at intervals of 25 ft. forming a rectangular vat. Pump water into these compartments and allow it to stand until it has leaked its way into the fill. This will disclose the weak spots and the engineer can take care of them as he thinks best.

The drainage of the graded portion of the road is of first necessity. Whatever plan is adopted, the one that will

*Paper presented before the American Road Congress, Detroit, Mich., Sept. 29-Oct. 4, 1913.

†Road Engineer, Cuyahoga County, Ohio.

most nearly maintain the sub-structure free from moisture below the frost line is the ideal condition to be sought. This means that you must not merely drain the road bed, but adequate side ditches must be provided to carry off promptly the accumulated water.

In the preparation of a sub-base the only debatable proposition is the purpose of rolling. Common practice, including the use of a very heavy roller, has been founded upon the theory of compacting the soil to as great a depth as possible. This can do no harm but I am personally inclined to believe that the chief purpose of rolling is accomplished when the weak or spotty places in the soil are revealed, so that the engineer can treat them as he sees fit. For this purpose, a roller weighing from eight to ten tons answers every requirement.

Preceding the final preparation of the sub-base the curbs must be placed. In case of most of our rural work, curbs are placed flush with the surface of the completed pavement.

With curb set and base prepared the next step is the placing of the concrete base, which with our roads has been 4 in. in depth. In specifying the proportions, a mixture of 1:3:5 with a permissible variation according to the size of the aggregates which will most nearly fill the voids, meets every necessity. To meet this variableness, it is necessary to specify the size of your coarse aggregate, but not the amount, requiring only so much of the coarse aggregate to be used as shall leave the concrete most nearly free from voids. This, instead of an inflexibile rule of proportions, will relieve you of many arguments and will assure you a condition of concrete whereby a smooth surface is easily attained. A smooth surface you must have, for upon that much both of efficiency and durableness of your wearing surface depends. It enables you to accomplish in the next step a requirement of equal importance, that of placing the sand cushion of uniform fill and of uniform density.

While personally I do not place as much importance as some people do in the ability of the sand cushion to afford resilience or absorb the shock effect, it is unquestionably a necessity for the purpose of bringing the wearing surface of the brick to a perfect plane, by neutralizing the unevenness and lack of uniformity of the brick.

No one will question but that the support of the wearing surface provided for by this sand cushion must be uniform. It is therefore necessary to compress and bring to a like density every part of this cushion. Dropping the sand cushion onto the base from dump wagons and leaving the bottom portion of the load untouched before striking off with a template is objectionable and renders the hand rolling difficult by having a dense pile and a loose pile to contend with, the roller spanning the looser portion. It is better to spread the sand entirely by shovels, then by rolling and striking off and re-rolling, even a third time. Thus you bring the cushion to an even density that not only will furnish an even support to the entire pavement, but will prevent the sand from flowing up into the joints of the brick when the brick surface is rolled. While it is not necessary for this cushion sand to be entirely free from soil and vegetable matter, it should be nearly so, otherwise its density cannot be maintained.

It is needless to go into the specifications for the brick further than to insist on lugs on the side, and grooves on the end of the brick. I do not mean that there should be no specification for the brick but that it is the place of the engineer to determine by the class of traffic in prospect, what percentage of loss shall be tolerated as a maximum in the latter test.

Granting that you are satisfied with your brick, their laying is the next proposition. First, see that the lugs are turned one way. Second, make certain that the joints are broken so that one third or more of the brick of one course overlaps the brick of the next course. Third, be sure that every fourth course is driven up to a straight line. Fourth, for the sake of appearance, keep the line of the brick at right angles with the curb.

Next in order is culling. Care should be taken to see that all soft brick or brick that are burned too hard are removed. Those so heavily kiln-marked that they will cause unevenness in the pavement should be turned. Caution should be exercised in this, for many a kiln-marked brick is thrown out which, if allowed to remain would have been of more value to the pavement than others that are retained.

After the brick are thus placed in the street, their slight unevenness should be ironed out by the use of a roller not exceeding five tons in weight. If a horse roller is used at all, it should have a diameter of at least 5 ft. Rolling should begin on one side and pursue a course parallel to the curb. The roller should return over the same course. The next trip should lap the first, the roller again returning over the same course. This should continue until the center of the pavement has been reached when the roller should be [illegible] to the opposite curb and continue as before until the [illegible] is reached from the other side.

The roller should then start at one side and work d[illegible] ally across the pavement. This diagonal rolling will h[illegible] a tendency to bed the brick in such a manner as to [illegible] "rockers." The pavement should then be culled agai[illegible] broken brick after which it should be hand rammed w[illegible] paver rammer weighing not less than 50 lb. Interp[illegible] plank not less than 6 ft. long, 10 in. wide and 2 in. [illegible] between the surface of the pavement and the rammer. [illegible] plank should be laid parallel to the curb.

For filling joints, the next process in order, use a [illegible] filler composed of equal parts of sand and cement. It [illegible] hardly necessary to state that the cement should meet [illegible] standard specifications for portland cement as adopted by the American Society for Testing Materials. The sand with which we have had much success has been taken from the lake and although not very sharp is nevertheless fine and clean and has given such good results that I cannot do otherwise than recommend its use. In any event the sand to be used should be free from sewage, acid or soil, and should be sharp and fine.

A watertight box, standing on uneven legs so as to afford a "lower corner" should be used as a receptacle for the grout. In it place not to exceed one cubic foot of sand and one bag of cement, mixing the mass until it assumes a uniform color. Add water and stir the mixture until it assumes the consistency of thin cream. The mixture should then be applied to the pavement by means of scoop shovels and thoroughly swept into the joints. After this has had sufficient time for setting, a second coat, slightly thicker should be applied and later a third coat which will assure filled joints. This last coat should be worked either with a specially prepared broom or a rubber squeegee and swept across the joints at an angle of 45°.

After the initial set has taken place, the pavement should be covered with a half inch or more of sand and this should be kept saturated with water for at least five days. The pavement should not be opened to traffic for at least ten days.

We have not undertaken any special provision against possible thermal effect, such as contraction and expansion due to low and high temperatures, but have relied mainly upon the condition of our structure by avoiding moisture underneath the roadway, and by an endeavor to have our cement-filler at the greatest possible strength. These provisions, together with a rigid curb, enable us to hold in compression the expansion occurring in our narrow roadways. In this respect, we have not been entirely successful. A few cracks in the pavement have appeared, but so far, they have not raveled out so as to injure the traffic worth of the road and have not been thought of sufficient importance to require repairs.

In trying to express the proven worth of such roads to the community, I am at a loss for words. Their economy has been proven in contrast with any other methods of road building from the cheapest to the most expensive. I make this statement after comparing the annual maintenance cost of other types of good road with the utter lack of any repair expense, on brick roads, due to ordinary wear. Our only repair expense has been caused by early mistakes in construction.

The fact that our roads are in shape for maximum service twelve months in the year and that they originate no dust has endeared them to abutting dwellers and to travelers from a distance. Washing by rain suffices to keep them clean and imparts a sanitary advantage which has been much emphasized by health authorities.

Perhaps the most eloquent praise is contained in the simple statement that, although we have built nearly 400 miles of such road, 33 farmers' petitions are now on file in our office, asking for 33 separate extensions. Local sentiment may be conservative, but it everlastingly catches on when it is shown something really good. We are no longer besought to make cheap roads, but to make good ones. Witness one case where assessments on a macadam road had still four years to run and yet so eager were the abutting owners for a better road that they threw four years payments into the discard and signed unanimous petition for brick. The petition was granted and brick laid, although it was necessary to scrap a relatively new macadam road to do so.

In a day when power traffic is imposing new tests upon road surfaces, and when the aggregate of all traffic is increasing so rapidly, I cannot avoid the feeling that we were fortunate in wasting little time and expense upon methods that could bring us no ultimate advantage. Our early ex-

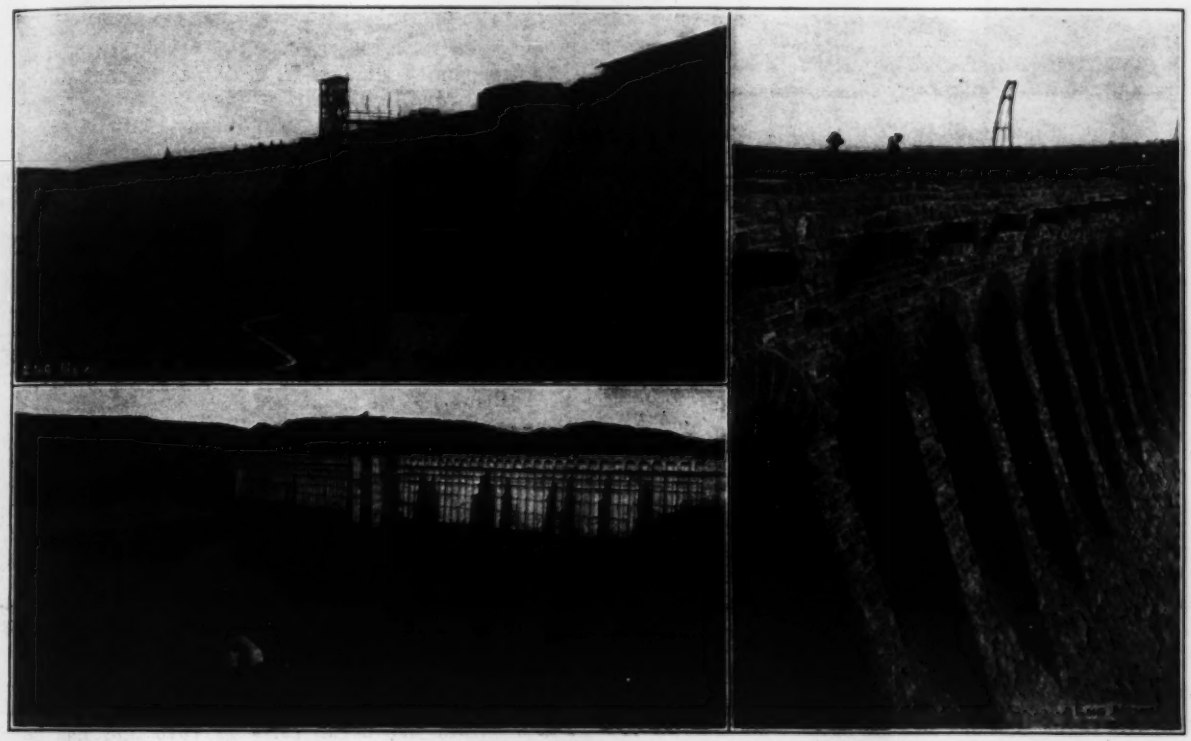
periments were often far from successful but they carried us along a course of evolution to something better than we could possibly anticipate. We must credit good luck alone for the fact that our venture dealt with a type of road peculiarly adapted to forms of traffic which could not be foreseen in 1893 when the experiments commenced. We can only claim credit for persistence in building year after year without a single omission for two decades, in refusing to be discouraged by failures and in availing ourselves of the only chance that any man can ask—the chance to correct his own mistakes.

## The Möhne Dam, Ruhr District, Germany

The most recent of Germany's large series of water-storage dams to be completed is shown in the three photographic views reproduced herewith. From data concerning the structure sent us by Dr. A. Gradenwitz, Berlin, we give the following.

The drainage area above the dam is about 160 sq.mi. It is estimated that the Möhne reservoir can store 53% of the total annual runoff from this area. Since the purpose of the work is equalizing the flow, the water stored in the reservoir being all discharged into the valley below, it is possible to utilize the water power created by the reservoir. For this purpose a power house is built just below the dam, in which are installed four turbine-generator units of 1600 hp. each.

The dam is 131 ft. in maximum height, and its cross-section is 112 ft. wide at the base. The crest roadway is 20 ft. wide. In plan, the dam is arched slightly upstream; its total length is 2100 ft. The structure is of stone, laid in cement. The water side is faced with two waterproofing coatings of lime-cement-trass mixture with a slight asphalt-emulsion addition; the waterproofing is protected by brick facing. The interior of the dam



THREE VIEWS OF THE MÖHNE DAM, RUHR DISTRICT, GERMANY
(Downstream face; upstream face, with construction staging; near view of crest masonry.)

The dam is located at the mouth of the Heve River, a confluent of the Möhne, the latter in turn being tributary to the Ruhr. The Ruhr Valley is the center of the great iron, coal and manufacturing district west of Düsseldorf, and the water of the Ruhr is utilized at many points. Extreme low-water periods of the Ruhr, which in occasional instances are so extreme that no runoff from the Ruhr reaches the Rhine, are therefore felt as a very severe hardship to the Ruhr region. Eight or ten years ago a conservation district was formed in the Ruhr Valley for the purpose of erecting storage dams to equalize the year's flow. The Möhne Dam is the largest of the storage works erected for this purpose, the reservoir behind it having a capacity of 4600 million cu.ft. and the total cost of the dam and auxiliary works being about $5,000,000.

has drain wells through it at intervals, to discharge into the valley below any water infiltrating through the masonry.

The dam was built by D. Liesenhoff, of Dortmund, contractor.

**Famous English Contracting Firm To Dissolve**—After 65 years of existence the firm of John Aird & Co., of London, England, is to be dissolved, although the retirement of the firm from business will be gradual and dependent upon the completion of contracts at present under way. Probably the most famous of the firm's work was the building of the Assuan dam across the River Nile in Egypt. The firm was founded by John Aird, a Ross-shire man, who left the service of a Greenwich gas company in order to embark in the business of laying gas and water mains in the city of London. The late Sir John Aird, son of the founder of the firm, assumed charge of important work when only 18 years of age.

# Camp Hill View Sanitation, Catskill Aqueduct

By Arthur W. Tidd*

Throughout the entire length of the Catskill Aqueduct, from the Ashokan Reservoir in the Catskill Mountains to New York City, approximately 120 miles, a sanitary supervision is exercised by the Board of Water Supply over the housing and living of the laborers employed on their work and the disposal of all wastes. The specifications for each contract require the contractor to provide for proper sanitation and in many cases specify just what these provisions shall be.

Historical—These wholesome sanitary provisions in connection with the building of this new, 500 million gallons daily water system mark another step forward in the improvement of the sanitary conditions of construction camps. The first definite action along this line with which the author is familiar was taken by the Metropolitan Water Board of Boston, Mass., when in 1895 preparations were under way for constructing the Wachusett Reservoir and Wachusett Aqueduct.† In the early specifications for this work the contractor was "to adopt and enforce promptly and fully such sanitary regulations in regard to the construction and maintenance of privies for his men, or arrangement of his shanties, as may be directed by the engineer." Other clauses were added from year to year as new specifications were written. In 1905 the city of Pittsburgh, Penn., embodied clauses in the specifications for its filtration works covering medical examinations, supervision of the housing of the men, and the disposal of all wastes in accordance with sanitary principles. The Cross River Dam and Reservoir, built by the Croton Aqueduct Commission of New York City, was being designed at about the same time, and those specifications are quite similar to the Pittsburgh ones. The early contracts on the Board of Water Supply work were quite similar to the Cross River specifications in this respect. When, however, in 1908, preparations were being made for the construction of the Catskill Aqueduct through the Croton watershed and from there south to New York City, the subject of the sanitary control was taken up afresh by the engineers of the Board and considered with great thoroughness. In some of the contracts the precautionary measures were so extensive and the sanitary clauses so rigidly [illegible] that a specific payment item was provided in the contract for the sanitary service and payment was [illegible] provided under other appropriate items for the construction of such special structures as were ordered.*

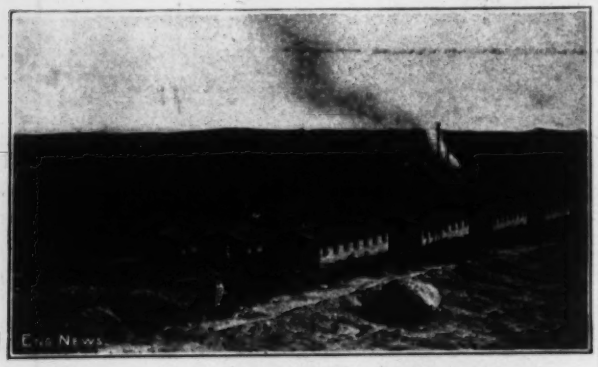


Fig. 1. Camp Hill View, Catskill Aqueduct

In 1909 the Board of Water Supply engaged Dr. [illegible] J. Lederle as Sanitary Expert. His duties were to consist in:

> Supervising all sanitary matters in connection with the work of the Board, the preparations of all plans and specifications in relation to such matters to accompany or be embodied in the contracts to be prepared by the Board of Water Supply, and devising and promulgating all proper rules and regulations in reference to such matters, including rules and regulations for the care and health of the employees of this Board, and of the contractors having contracts with the Board, for the erection and maintenance of camps and hospitals and the proper inspection and supervision of the operations under said contracts, with reports from time to time, and as often as may be necessary, or required, to the Chief Engineer of the Board in regard to such matters.

Dr. Lederle resigned in January, 1910, to become Commissioner of Health of New York City, and the Board appointed Herbert D. Pease, M. D., and Andrew J. Provost, Jr., C. E., both of New York City, to succeed him. Dr. Pease and Mr. Provost, with Dr. David S. Flynn as their representative in the field, have continued to date in charge of this branch of the Board's work. As a part of their duties all camp sites and all plans for the camp layout are subject to their approval. Proper provisions must be made for a potable and ample water-supply, for a proper sewerage system and for safeguarding the health of others in the vicinity. The most extensive and rigidly enforced precautions are taken when work is being conducted within the limits of a watershed which is tributary to a public water-supply. Plans for all camp buildings are submitted for their approval before beginning work on the contract itself. And all through the life of the contract, as will be described later, a most thorough and continual inspection and supervision is maintained over all matters allied in a sanitary way to the contract and the laborers.

This paper describes the camp and the sanitary measures in operation in "Camp Hill View," the camp established in connection with Contract 30 for the construction of the Hill View Reservoir. The estimated value of this contract is $3,269,000 and the time for completion is 6 years and 4 months. The contractor is the Keystone State Construction Co., of Philadelphia, Penn. Work was begun early in 1910 and has been actively prosecuted since that date.

General Description—The camp is located on nine acres of leased land adjoining the site purchased by the city for the Hill View Reservoir (see maps in Fig. 2). It lies within the limits of the City of Yonkers, just north of the northern limit of New York City and about midway between the City of Yonkers and the City of Mount Vernon. The locality is fairly well built up with houses of moderate rent, occupied by people employed in Yonkers, Mount Vernon and New York. Street railroads are operated throughout the district in all directions. There is no sewerage system but all other city conveniences have been provided. The reservoir is located at the southern extremity of a high, narrow ridge of

*Assistant Engineer, Board of Water Supply, 215 Kimball Ave., Yonkers, N. Y.

†At that time Nashua Reservoir and Nashua Aqueduct.

*For a more complete history of the evolution of these sanitary specifications, see the discussion of the paper, "The Sanitation of Contractors' Camps and the Patrol of Watersheds," A. J. Provost, Jr., author, by T. H. Wiggin and Morris Knowles, Jour. Assoc. Eng. Soc., June, 1912.

glacial origin extending in a northerly direction. The site selected for the camp slopes gently to the east, draining into a small water course about two hundred feet away, a tributary of the Bronx River. A large expenditure was necessary to clear the site of underbrush and boulders, to build blind drains for lowering the water table and ditches to care for the surface drainage.

posal and a large Woodruff pit for destroying garbage and general camp rubbish. The buildings and surrounding spaces are lighted by electricity from sunset to sunrise. The commissary, hospital and power house are connected by telephone. The buildings are well-built, wooden-frame structures, those for habitation being set on posts well above the ground. They are constructed

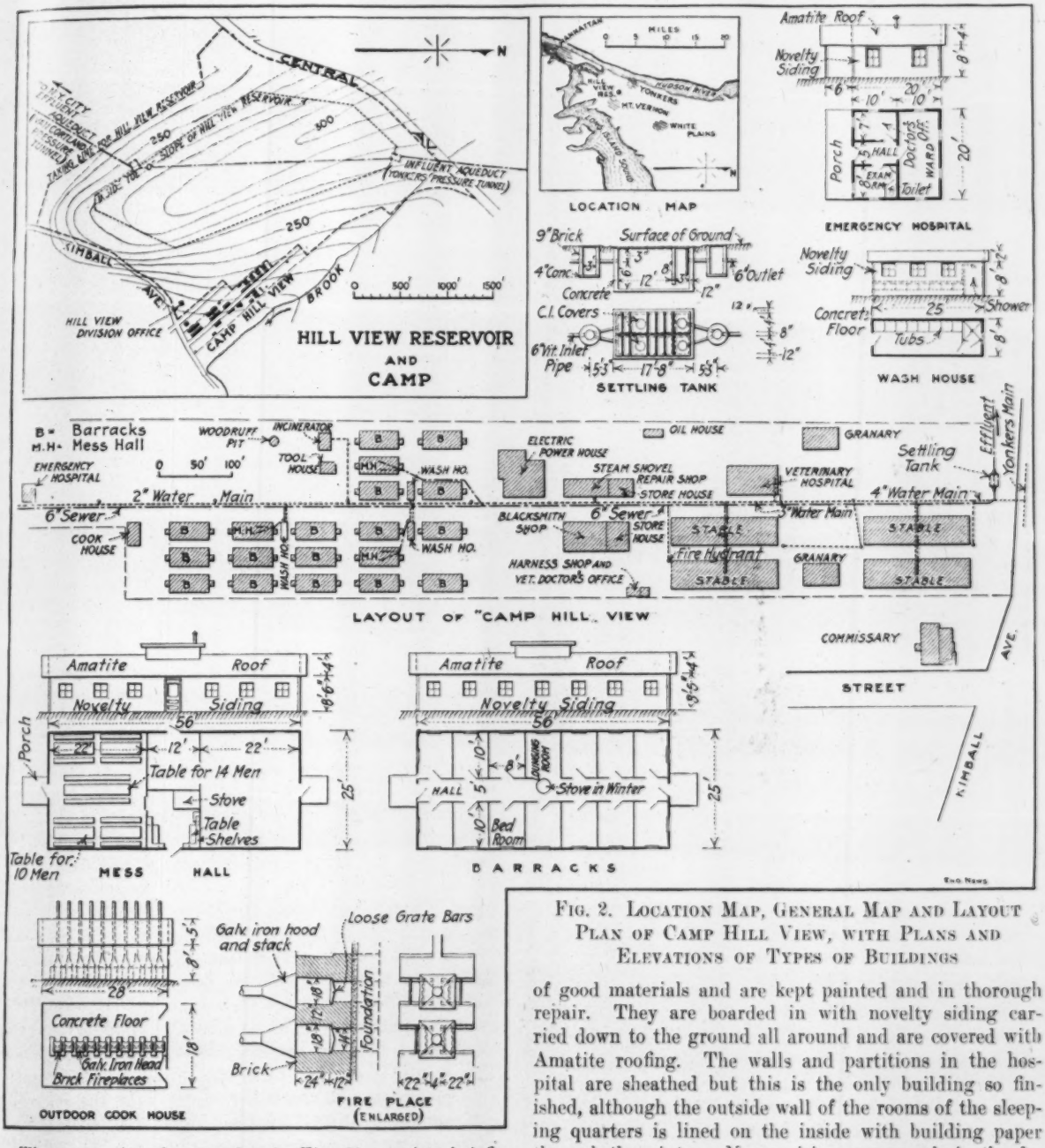



Fig. 2. Location Map, General Map and Layout Plan of Camp Hill View, with Plans and Elevations of Types of Buildings

The camp (see layout plan in Fig. 2) consists briefly of 16 barracks or sleeping quarters, 3 mess halls, a commissary, an emergency hospital, an outdoor cook house, an incinerating plant, 3 washhouses, 4 stables, a veterinary hospital, 2 granaries, 3 shops and a power house for generating electricity, all systematically arranged along a central street. It has a water-supply connected with the City of Yonkers system, hydrants for fire protection, a sewerage system with a settling tank for disposal and a large Woodruff pit for destroying garbage and general camp rubbish. The buildings and surrounding spaces are lighted by electricity from sunset to sunrise. The commissary, hospital and power house are connected by telephone. The buildings are well-built, wooden-frame structures, those for habitation being set on posts well above the ground. They are constructed of good materials and are kept painted and in thorough repair. They are boarded in with novelty siding carried down to the ground all around and are covered with Amatite roofing. The walls and partitions in the hospital are sheathed but this is the only building so finished, although the outside wall of the rooms of the sleeping quarters is lined on the inside with building paper through the winter. No provisions were made in the design of the camp for accommodating men with families and with the exception of one instance where a family lived in a tent for a portion of one summer and in a few others where a man and his wife ran one of the mess halls, no women have been in the camp. No separate houses were built and none are allowed to be built by the men. No trouble has been experienced by those having families in finding suitable houses in the vicinity of the

work. All persons in camp are obliged to sleep in the barracks.

Sleeping Quarters—The sleeping quarters or barracks (shown as part of Fig. 2) are all alike, 25x56 ft. in plan, 12½ ft. to the ridge with a 12-ft. louver. The rooms are 8x10 ft., arranged along a central hall running the length of the building. They are built tight to a height of 8 ft. and above that the partitions between the rooms and along the hall are latticed to the roof, providing thorough ventilation. There are 7 rooms on one side and 6 on the other, one room in the center being used for a general lounging room. A large coal stove similar to the familiar station heater is set up in the hall at this point during the winter; it is the only

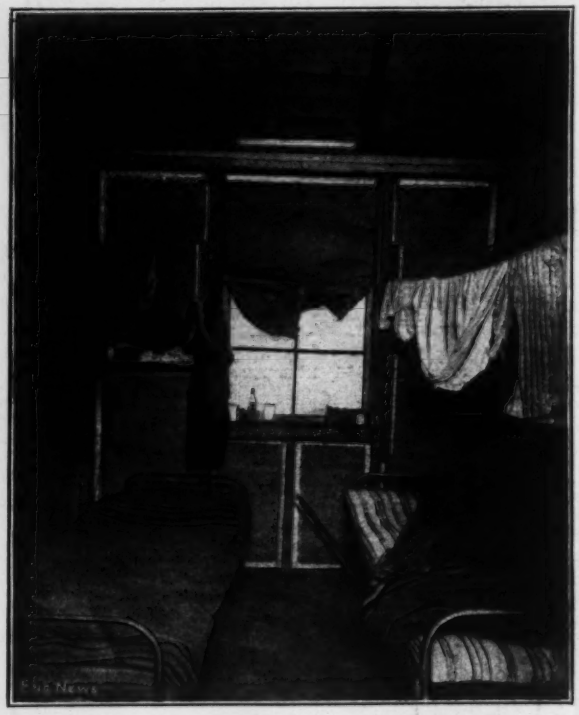


Fig. 3. Laborers' Sleeping Room, Camp Hill View Barracks

means provided for heating the building and is sufficient for the purpose. The exposed wall of each room is covered on the inside with building paper through the winter. Each room (Fig. 3) has a door and a 3x3-ft. sliding window. At each end of the hall is a panel door, the upper half glazed, and in the summer screen doors are added. All windows have fixed wire screens through the summer and the louver is screened. Two men are allowed to occupy a room together, two separate iron spring cots with mattress being furnished with each room. Each room contains over 800 cu.ft. of air space without counting the free ventilation into the hallway. No cooking is allowed in the building. The barracks are swept out daily and the sweepings taken to the Woodruff pit. No objections to the two-men rooms were ever raised by the men; in fact they seem to prefer them. The rooms have a decided effect on the successful maintenance of generally orderly conditions inside the buildings.

Mess Halls—The mess halls (Figs. 2 and [illegible] are alike, 25x56 ft. in plan, 12½ ft. to the ridge and [illegible] to the roof. Each building is divided into two [illegible] establishments, each consisting of a kitchen and [illegible] room, by a partition tight from floor to roof and [illegible] no means of passing from one establishment [illegible] other. The building has a louver similar to those [illegible] barracks. Each dining room is equipped with 5 [illegible] tables and benches capable of seating 54 men. The tables are covered with oil cloth. Each kitchen is provided with a coal range, a sink with a drain connected with the sewer, two tables and several rows of shelving. There is no running water in the building and water is obtained from the wash houses or taps near-by. There are many sliding windows and an outside door to each dining room and each kitchen. Screen doors are provided and all windows and louvers are covered with fixed-wire screens through the summer. Each mess hall is run by two men or by a man and his wife. The rooms are regularly washed and swept and kept in a neat and orderly condition.

Wash Houses—The wash houses (Fig. 2) are 8x25 ft. in plan and 10 ft. to the ridge; 4½ ft. at one end is partitioned off for a shower bath. A zinc-lined wooden wash trough about 2x2 ft., divided by zinc-covered partitions into 8 compartments, each with a faucet supplying running water, occupies one side of the remaining length of the building. The floor is concrete. The shower bath and trough are connected with the sewer.

Cook House—The outdoor cook house (Fig. 2) is 18x28 ft. in plan, 13 ft. to the ridge, the sides covered with corrugated sheet-iron and provided with two doors. There are 20 fireplaces arranged in two rows back to back, one galvanized-iron hood and smoke stack serving each pair. The fireplaces are built of brick. The floor is concrete. Ample provision is made for circulation and ventilation by leaving off the siding in each end in the peak and more openings are made in the summer. This cook house has not been entirely successful in eliminating the individual outdoor cook house or shack and the subject is taken up in detail later on in this paper.

Emergency Hospital—The hospital (Fig. 2) is provided and equipped for the proper treatment of all minor accidents and illnesses, arrangements being in force with hospitals in the vicinity to handle all serious cases. The building is 20x20 ft. in plan, 12 ft. to the peak, with a porch extending across the entire front. One-half is partitioned off for a ward and the other half is divided into an office about 6x9 ft. for the doctor, a 5-ft. hall leading to the ward and an examination room about 7x9 ft., containing a wash basin with running water and a toilet connected with a cesspool. The building is heated by a stove and is completely screened in the summer. The ward is supplied with iron-spring cots, mattresses and coverings, and the other rooms with the necessary cabinets for medicinal supplies, desks and chairs. The walls and partitions are sheathed.

Sanitary Conveniences—For the use of the laborers on the work some 15 or 20 pan closets, well built but light enough to be readily moved about as needed, are provided. A hinged ridge is used for a seat. The whole interior is open and can be readily cleaned. The pans are made of heavy galvanized iron, 15x18 in.x8 in. deep, one to each closet. For those in the camp, the four corners of the incinerator house are partitioned off into in-

dependent toilets, entered only from the outside, 2 for the men having 6 seats each and 2 for the women having 3 seats each. The galvanized-iron pans are used here also being removed from the backs of the closets on the inside of the building. All persons are required to use rubbish (which are collected daily) to keep a smouldering fire but kerosene is thrown in whenever there seems to be any need for it; perhaps a gallon per day would be a fair average. The pit works very satisfactorily and requires little attention. There is very little odor.

FIG. 4. MESS HALL AT CAMP HILL VIEW, CATSKILL AQUEDUCT

these conveniences. The portable sanitaries are well taken care of and are not offensive. The seats and floor of the toilets in the incinerator house are thoroughly washed out with a hose daily. The pans on the work are collected daily by one man with a horse and light wagon. They are emptied into the furnace, washed on a washing platform in the rear of the incinerator house with a stream of water and turned upside down to dry. Chloride of lime is applied daily over the area affected by this washing.

INCINERATING FURNACE—The contents of the pans are incinerated daily in a large brick furnace of the grate-bar type, operated without water-tight ovens. A complete description of the construction and operation of this furnace was published in ENGINEERING NEWS Jan. 23, 1913. It was planned to increase the height of the stack in case the odors should become a nuisance when the furnace was in operation (from 6 to 12 hours daily) but it has never been considered to be necessary.

WOODRUFF PIT—All garbage, sweepings from the buildings, bottles, empty cans, papers and rubbish collected around the camp site, are burned in a large Woodruff pit. The pit (Fig. 5) is circular, about 13 ft. in diameter and 4 ft. deep, with vertical sides lined with field stone. The edge is flush with the surface of the ground. A brick cone about 9 ft. high and 5 ft. in diameter at the base, with a central flue and many openings near the bottom, is built in the center of the pit to furnish the draft and conserve the heat. There is usually enough combustible material in the sweepings and

SINK WASTE SYSTEM AND DISPOSAL—A 6-in. vitrified pipe sewer runs the length of the camp, with connections from the mess halls, wash houses and watering troughs in the stables. No excrementitious matter is turned into the sewer. The watering troughs in the stables effect a very considerable dilution by delivering some 4000 to 5000 gal. daily of practically clean water into the system. The troughs are semi-circular in cross-section, 18 in. in diameter, and extend the length of each stable (140 ft.) between the stalls. They are filled about half-full and emptied morning and evening. The sink waste

FIG. 5. WOODRUFF PIT FOR BURNING GARBAGE AND RUBBISH, CAMP HILL VIEW

flows into a two-compartment settling tank (shown as a part of Fig. 2) about 10x17 ft. in plan and 9 ft. deep, each compartment having a baffle wall 3 ft. from the outlet extending to within 12 in. of the bottom. The effluent is drawn from a point 3 ft. below the level of the liquid in the tank by means of a 6-in. T, with an arm projecting downward, and is discharged into a small stream about 200 ft. away that empties into the Bronx River. By means of a manhole at each end of the tank either compartment can be thrown out of commission for inspection, cleaning or repairs. The entire system has given very satisfactory service.

WATER-SUPPLY—A main connected with the city of Yonkers system runs through the camp, supplying wash houses, stables, numerous valves, faucets and the hydrants for fire service. Yonkers water is also piped around the job to supply locomotives, steam shovels and the like. The water boys are required to use this water.

SANITARY CLAUSES OF THE CONTRACT—The clauses in Contract 30 relating specifically to the sanitary measures are given below complete. They form a component part of the regular specifications for the construction of the reservoir. In order to further emphasize them and lest a bidder should overlook or underestimate their importance, a special paragraph in italics is placed in the brief statement at the beginning of the book in the "Information for Bidders" stating that "The sanitary regulations and the provisions relating thereto are particularly called to the attention of intending bidders." These clauses follow:

Sec. 59. SANITARY PRECAUTIONS—The contractor and his employees shall prevent nuisances in and about the works; shall protect water-courses, reservoirs, wells and other sources of water-supply, public or private, from pollution, contamination or interference, and safeguard the public health, as may be directed from time to time by the constituted authorities of the state and city. The contractor shall summarily dismiss and shall not again engage, except with the written consent of the Engineer, any employee who violates this section.

Sec. 60 INSPECTION BY THE ENGINEER—The Engineer shall have the right, in order to determine whether the requirements of this contract as to sanitary matters are being complied with, to enter and inspect any building or any part of the work, and to cause any employee to be examined physically or medically or to be vaccinated or otherwise treated; also to inspect the drinking water and food supplied to the employees. The sanitary precautions, the care of the employees, the buildings, and all territory occupied by the contractor shall at all times be satisfactory to the Engineer. The contractor shall promptly and fully and in every particular, comply with all orders and regulations in regard to these matters, including all sanitary and medical rules and regulations which may have been or may be promulgated from time to time. And to this end and to properly preserve the peace, the Board of Water Supply Police shall have the right of access to the contractor's quarters.

Sec. 61. MEDICAL AND SURGICAL ATTENDANCE—The contractor shall retain the services of a sufficient number of acceptable qualified medical and surgical practitioners who shall have the care of his employees, shall inspect their dwellings, the stables and the sanitaries as often as required, and shall supply medical attendance and medicines to the employees whenever needed.

HOSPITAL AND AMBULANCE SERVICE—The contractor shall make satisfactory arrangements for hospital and ambulance service and shall provide on the work and maintain in satisfactory condition a small building for an emergency hospital, where injured or sick employees can be given temporary relief until the arrival of an ambulance. Such building shall be heated, ventilated and screened, and shall contain a suitable number of beds and proper articles for giving "First Aid to the Injured" and for relieving ordinary forms of illness.

Sec. 62. STABLES AND OTHER BUILDINGS—All buildings erected on the land of the city for housing, feeding or sanitary necessities of the men or for stables for the animals employed on the work shall be built only in accord... with approved drawings and specifications at designated ...ces. All buildings occupied by employees shall be th... ...hly screened to exclude mosquitoes and flies.

Sec. 63. MEDICAL SUPERVISION OF EMPLOYE... The medical supervision of the contractor over his e... ...ees shall extend to the physical and medical examinatio... all applicants for employment, in order to prevent perso... ...av- ing communicable disease from becoming connected ... the work, and the contractor shall employ only person... ...own by such examination to be free from communicable d... ...ses. Whenever in the opinion of the Engineer it is neces... for the protection of the public health or the health of ... ...em- ployees, the contractor shall remove any employee fr... the work to a hospital or shall permanently remove fr... the work any employee whose presence is believed to en... ...ger the health of other persons.

Sec. 64. HEALTH REPORTS—Once each week o... ...ore frequently, if required, the contractor shall give the ...gi- neer, in such detail as may be prescribed from time to ...me, a written report signed by the physician in regular a...nd- ance, setting forth clearly the health conditions of the ...ild- ings, of the grounds and of the employees. If any ca... of communicable disease be discovered or any case of do...tful diagnosis, it shall be reported at once to the Engine... by telephone or messenger and confirmed in writing.

Sec. 65. SANITARY CONVENIENCES AND DISPOSAL OF EXCRETA—Buildings for the sanitary necessities of all persons employed on the work, beginning with the first men employed for preliminary operations, shall be constructed and maintained by the contractor in the number, manner and places ordered. All persons connected with the work shall be obliged to use these conveniences under penalty of discharge. In addition to the above, closets having watertight removable receptacles, shall be provided and properly cared for in the tunnels and elsewhere, whenever necessary for the prevention of nuisances. These receptacles shall not be allowed to overflow, but shall be removed without spilling, at required intervals, their contents at once treated as directed and then promptly taken to a designated place and there disposed of as ordered. If incinerators be used they shall be efficiently operated. The Contractor shall provide a sufficient number of acceptable attendants to keep all sanitaries in satisfactory condition, and compel employees to use them. The contractor shall rigorously prohibit the committing of nuisances in the completed or partially completed structures or upon the land of the city about the works or upon adjacent private property.

Sec. 66. CONTRACTOR TO BUILD SANITARY WORKS—The contractor shall build such disposal plants, sewers, drains and other structures, and shall do such other work not herein particularly specified, as may be necessary for carrying out the intent of the sanitary precautions of the contract.

Sec. 67.—GARBAGE DISPOSAL—Garbage, both liquid and solid, shall be promptly and satisfactorily removed from the buildings and immediately placed in approved tight receptacles of sufficient capacity for about one day's ordinary production. At least once in 24 hours all such garbage shall be incinerated or otherwise thoroughly and satisfactorily disposed of.

Sec. 68. DISPOSAL OF WASTE WATER AND STABLE DRAINAGE—All wash water from kitchens, laundries and other places and all drainage from stables shall be conveyed by satisfactory means to places directed, where such drainage shall be treated by the means ordered.

Sec. 70. SANITARY PRECAUTIONS TO BE SATISFACTORY—The sanitary precautions described in Sections 59 to 69, inclusive, shall at all times be satisfactory to the Engineer, to the Department of Health of the City of New York, and to the local and State Boards of Health. The Contractor shall promptly and fully comply with all orders and regulations in regard to these matters.

Sec. 71. NO DIRECT PAYMENT FOR CONTRACTOR'S PLANT NOR CONSTRUCTION OF SANITARY WORKS—For providing plant, tools and equipment and for furnishing, erecting and removing the construction plant, quarters for men, stables, sewage and garbage-disposal works, water-supply and other temporary works, the contractor shall receive no direct payment, but compensation for them shall be considered as having been included in the prices stipulated for the appropriate items.

Sec. 72. PAYMENT FOR SANITARY SERVICES AND MAINTENANCE OF SANITARY STRUCTURES—For furnishing the necessary professional services, labor, materials and other requisites for the care and maintenance of the sanitaries, the collection, disinfection and disposal of garbage, excreta and other wastes, maintenance and operation of sewers, sanitary drains and disposal works, removal of objectionable matter whenever ordered from any part of the works,

care of the health of employees and for all other services necessary for carrying out the provisions of Sections 59 to 70, and such rules and regulations as may be issued thereunder from time to time, the contractor shall receive in full compensation the price per month stipulated in Item 62.

Sec. 69, omitted, refers to the possible use of a blowoff to be built in connection with the reservoir, for waste waters.

The monthly payment under Sec. 72 is $400. The prices bid for this item by the various bidders on this contract were $400, $300, $300, $250, $500, $50, and $200; the $400 being that of the lowest total bid received (Keystone State Construction Co.) and the $200 that of the highest.

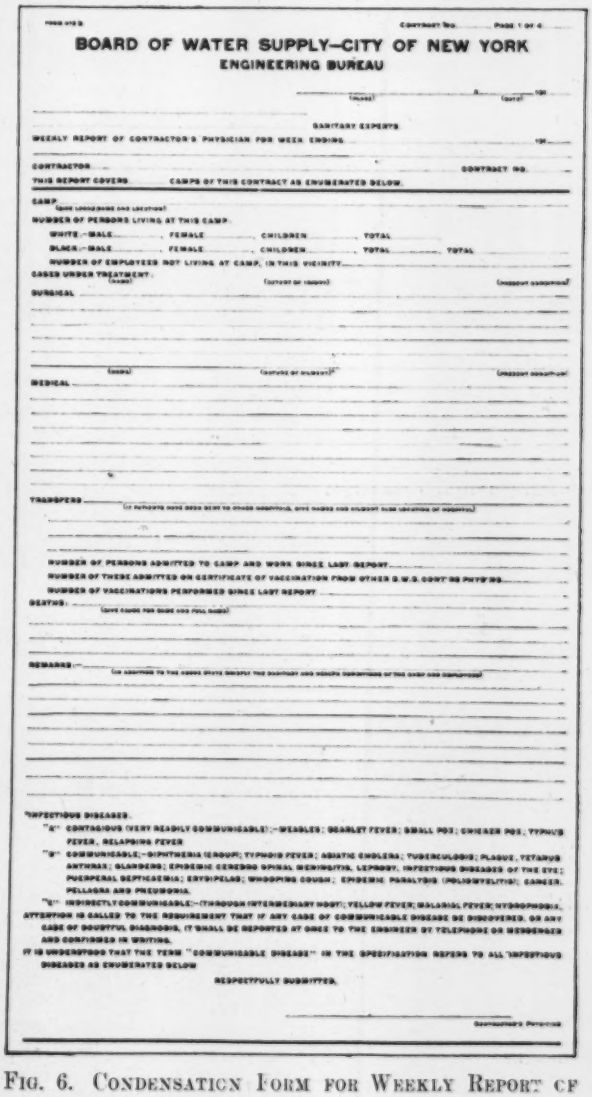
THE CARRYING OUT OF THE SANITARY MEASURES—This direct payment for sanitary services is new in contract work. It reimburses the contractor for his necessary expenditures in this direction and places him in a position to coöperate with the engineers in carrying out the sanitary clauses. This attitude was taken at the beginning of the work and has been admirably maintained. The plans for the buildings and all the details of the camp were submitted by Henry Delaplaine, chief engineer of the contractor, for the approval of the engineer and the sanitary experts of the board and they were carried out as approved.

The buildings are kept in repair and in a neat and orderly condition. The sleeping quarters are swept out daily and the refuse taken to the Woodruff pit. A man is detailed to the work of going through the camp daily gathering up papers, bottles, empty tins and miscellaneous refuse and rubbish. The pans from the closets around the work are collected daily by wagon by one man who also charges the incinerator, tends the fires and cleans and washes down the incinerator house and the toilets in the building. The mess halls are clean and wholesome. No garbage is allowed to accumulate and no wash water is allowed to be thrown out of doors or windows. The garbage is taken promptly to the Woodruff pit and cast in with the other refuse. The manure and bedding from the stables are carted away daily to farms or greenhouses. The urine in the stables is largely absorbed by the manure and bedding. Cesspools were designed to be used with each stable but they were never built and no annoyance has ever arisen from this source. The fact that the horses leave the stables in the morning and do not return to them until night accounts for the fact that there is a smaller amount of urine to be cared for here than in most stables.

A factor which contributes in no small degree to the excellent conditions that obtain in the camp is the Board of Water Supply Police. This branch of the Board's organization was organized pursuant to legislative requirement for the purpose of preserving the peace among the 16,000 laborers along the line of the aqueduct and for the protection of the communities from acts of violence and lawlessness. As a part of their duties a patrol is maintained, day and night, throughout the camp and vicinity and their presence alone tends to prevent many breaches of sanitary discipline. A few arrests are however found to be necessary each year in order to enforce compliance with the regulations.

MEDICAL SUPERVISION—Under the requirements of Sec. 61 of the contract and specifications, a suitably qualified medical practitioner was engaged by the contractor at the start of the work. This physician employs a doctor who is always at the emergency hospital or within easy call. Arrangements are in force with a hospital in the vicinity for ambulance service and for taking care of all serious cases.

A physical examination is made of all employees entering the camp or applying for work on the reservoir and the report of the examination is a factor in the acceptance by the contractor. Open cases of tuberculosis are rejected. Also an employee on the work may be removed if his presence is likely to endanger the health of others.



BOARD OF WATER SUPPLY—CITY OF NEW YORK
ENGINEERING BUREAU

SANITARY EXPERTS

WEEKLY REPORT OF CONTRACTOR'S PHYSICIAN FOR WEEK ENDING

CONTRACTOR CONTRACT NO.

THIS REPORT COVERS CAMPS OF THIS CONTRACT AS ENUMERATED BELOW.

CAMP.

NUMBER OF PERSONS LIVING AT THIS CAMP.

WHITE—MALE FEMALE CHILDREN TOTAL

BLACK—MALE FEMALE CHILDREN TOTAL TOTAL

NUMBER OF EMPLOYEES NOT LIVING AT CAMP, IN THIS VICINITY

CASES UNDER TREATMENT.

SURGICAL

MEDICAL

TRANSFERS

NUMBER OF PERSONS ADMITTED TO CAMP AND WORK SINCE LAST REPORT

NUMBER OF THESE ADMITTED ON CERTIFICATE OF VACCINATION FROM OTHER B.W.S. CONT'RS PHYS'NS

NUMBER OF VACCINATIONS PERFORMED SINCE LAST REPORT

DEATHS.

REMARKS.

"INFECTIOUS DISEASES.

"A" CONTAGIOUS (VERY READILY COMMUNICABLE):—MEASLES; SCARLET FEVER; SMALL POX; CHICKEN POX; TYPHUS FEVER; RELAPSING FEVER

"B" COMMUNICABLE:—DIPHTHERIA (CROUP); TYPHOID FEVER; ASIATIC CHOLERA; TUBERCULOSIS; PLAGUE; TETANUS ANTHRAX; GLANDERS; EPIDEMIC CEREBRO SPINAL MENINGITIS; LEPROSY; INFECTIOUS DISEASES OF THE EYE; PUERPERAL SEPTICAEMIA; ERYSIPELAS; WHOOPING COUGH; EPIDEMIC PARALYSIS (POLIOMYELITIS); CANCER; PELLAGRA AND PNEUMONIA.

"C" INDIRECTLY COMMUNICABLE:—(THROUGH INTERMEDIARY HOST); YELLOW FEVER; MALARIAL FEVER; HYDROPHOBIA.

ATTENTION IS CALLED TO THE REQUIREMENT THAT IF ANY CASE OF COMMUNICABLE DISEASE BE DISCOVERED, OR ANY CASE OF DOUBTFUL DIAGNOSIS, IT SHALL BE REPORTED AT ONCE TO THE ENGINEER BY TELEPHONE OR MESSENGER AND CONFIRMED IN WRITING.

IT IS UNDERSTOOD THAT THE TERM "COMMUNICABLE DISEASE" IN THE SPECIFICATION REFERS TO ALL INFECTIOUS DISEASES AS ENUMERATED BELOW

RESPECTFULLY SUBMITTED,

FIG. 6. CONDENSATION FORM FOR WEEKLY REPORT OF INFECTIOUS DISEASES USED AT CONTRACTORS' CAMPS

(Each page of the form is about 8½x11 in. overall. Each form covers three camps; the matter repeated has been omitted here.)

Vaccination against smallpox is compulsory and a certificate is issued to the men when vaccinated which is accepted on any other part of the Board's work if not over a year old. The New York City Department of Health supplies vaccine, diphtheria and tetanus antitoxines, antistreptococcus serum and typhoid vaccine free to the contractor's physician but the contractor is expected to furnish all other medical supplies. The doctor makes an inspection daily of all the buildings, entering each room in

the sleeping quarters, inspecting the incinerator and the general condition and appearance of the camp. He reports all irregularities and follows them up until they are corrected. Once a week a very complete report is made out in triplicate on a blank form furnished by the Board (Fig. 6), one copy going to the sanitary experts, one to the Department Engineer and one filed in the office of the division on which it originates. The report gives, among other things, the number of men, women and children in the camp, and the number admitted during the week. Vaccinations are recorded, the name of all persons receiving medical attention, the nature of their ailment and their condition on the day of the report. Cases requiring surgical treatment are described and the name of the hospital given in case the patient was taken there. The report shows the number of men employed on the work and not living in the camp and a statement of the general sanitary and health conditions of the camp and employees. Deaths are recorded giving the name of the person and the cause of the death. Cases of contagious disease and the like are reported immediately to the New York office of the sanitary experts, using telephone or telegraph and a code prepared for the purpose. Laboratory examinations are promptly made of samples from suspected cases. In short, all possible speed is made whenever there is the slightest evidence of any serious ailment, to obtain a correct diagnosis or to put preventive measures into operation. To those communicable diseases designated on the prescribed form of physicians report (Fig. 6) were added in 1911 under "B" Epidemic Paralysis, Cancer, Pellagra and Pneumonia, and under "C" Hydrophobia.

STATISTICS—The following statistics have been tabulated from the physicians weekly reports during 1911 and 1912:

| | 1911 | 1912 |
|---|---|---|
| Weeks covered by reports | 52 | 52 |
| Average number living in camp | 333 | 336 |
| Average number living outside of camp | 413 | 236 |
| Maximum number living in camp | 385 | 450 |
| Surgical cases treated | 178 | 189 |
| Medical cases treated | ... | 100 |
| Typhoid cases | ... | ... |
| Malaria cases | ... | 20 |
| Measles cases | ... | 1 |
| Whooping cough cases | ... | 1 |
| Diphtheria cases | ... | ... |
| Scarlet fever cases | ... | ... |
| Influenza cases | ... | ... |
| Erysipelas cases | ... | 3 |
| Acute dysentery cases | ... | 2 |
| Pulmonary tuberculosis cases | ... | ... |
| Pneumonia cases | ... | 6 |
| Bronchitis cases | ... | 13 |
| Rheumatism cases | ... | 10 |
| Tonsilitis cases | ... | 7 |
| Mumps cases | ... | 2 |
| Meningitis cases | ... | ... |
| Deaths—violent | 1 | 2 |
| Deaths—natural causes | ... | 3 |

The record of the medical cases in 1911 is not as complete as the record for 1912 and is omitted except for typhoid. 1912 may be considered as typical for all cases in that year were recorded where the person was confined to his room or where, in an ordinary family, a physician would have been called. No case is entered twice, even though treatment may have been given for more than one week.

The number living in camp through the summer months ran about 440 in 1911 and about 400 in 1912. During 1911, 5 surgical and 1 medical case were sent to the hospital and 16 surgical and 14 medical in 1912. 276 vaccinations were made in 1911 and 179 in 1912. Prior to Jan. 1, 1911, 925 persons had been vaccinated.

THE OUTDOOR COOKING PROBLEM—No one will dispute that the outdoor cook house, the familiar shack of stones or boards and roofed with old tin or sheet iron, with the usually accompanying unsanitary conditions and unwholesome sights and odors, is objectionable and ought to be eliminated absolutely. The problem often presents complications, however, and some of these are set forth herewith, followed by a statement of the conditions existing in Camp Hill View.

Irish, Negroes, Hungarians, Austrians, Poles and Swedes prefer to have a woman prepare their meals and they will eat in the mess halls without any question. Italians and Portugese, however, persist in cooking their own food and in building a shack to do it in. The custom is a deeply rooted habit of the race, the question of economy not entering as an important element, although both nationalities are very frugal. These men combine into small groups, usually for the reason that they come from the same township in the "old country," or that they speak a similar dialect, and the members of each group insists upon cooking and eating by themselves, although mingling freely at other times. Thus it is that the outdoor cook house in this camp, with its 20 fireplaces, is not looked upon with favor. There will always be found one man in each group whom the others will look to as a sort of leader, a man usually of more intelligence and through whom sometimes a certain amount of reform can be brought about if one cares to go into it to that extent. Usually, however, any interference with this most tenaciously-clung-to custom is resented and the groups are often so closely bound together that the discharge or disciplining of one of their number will result in all leaving the work. The shack unquestionably acts as a sort of bond between the men and the job. If they find that they are to be permitted to follow this cherished custom they settle down, so to speak, and are not interested in looking elsewhere for work, a very desirable attitude from the contractor's point of view. It is among the Italians and Portugese that the cheapest class of labor is obtained, so the simplest solution would be for the contractor to pay a wage high enough to attract other nationalities and then prohibit the shacks absolutely, a solution, however, that cannot often be brought about. The way the matter stands in Camp Hill View at present is to permit the shacks in a limited number, to concentrate them in one locality, and to give especial attention to this area in the daily cleaning up around the camp. This area should be cleaned early each morning as the evening meal is the only one for which any considerable amount of food is prepared and cooked and, therefore, is the source of the scraps and garbage that, by decomposition, cause the unsanitary conditions and attract flies. The area in this camp is systematically cleaned, washed down several times through the summer with a stream of water from the fire hose, and is not offensive in smell or appearance.

CONCLUSION—The camp presents a neat and orderly appearance, free from offensive sights and odors, and has few flies or mosquitoes during the summer. During the two years and eight months that the camp has been in operation, it has been visited by many interested in social as well as sanitary problems. The health records are very satisfactory and the absence of fly-borne diseases is noticeable. No difficulties have ever been thrown in the way of those whose duty it has been to

see that the regulations were being carried out but experience has proven that a certain amount of vigilance is essential to the keeping up of the standard. One direct result of the supervision is manifest in the general character of the contractor's force. They are of a higher physical standard than in most camps. They are contented and law abiding. There is very little disorder either on the work or in the camp. The work has proceeded with no delays, with little friction and doubtless with more efficiency, a fact of importance to the contractor from a practical standpoint and indirectly to the Board with its desire to deliver water to New York City at the earliest possible moment. From a sanitary and humanitarian point of view it has certainly registered a long forward step and the results are most satisfactory to those who have the interests of the measures at heart.

J. Waldo Smith is chief engineer of the Board of Water Supply, Frank E. Winsor is department engineer and Chas. E. Wells is division engineer, in charge in the field of the construction of this portion of the line.

## Committee Reports on Sewerage and Sewage Disposal and on River Cleaning

The sanitary enginering section of the American Public Health Association has a number of standing committees. Among the reports submitted by these committees at the meeting held in Colorado Springs in September of this year was one on sewage collection and disposal, and another on river cleaning. Abstracts of these reports are given below, together with some points brought out in a paper on shell fish and sewage disposal, which was in a measure supplementary to the report of the first named committee.*

### Committee on Collection and Disposal of Sewage

The members of this committee are Geo. S. Webster, chairman, Frank A. Barbour, Geo. A. Johnson, F. Herbert Snow, J. L. Ludlow and Langdon Pearse. The report of the committee partook largely of the nature of a concise summary of the principles governing sewerage and sewage-disposal systems at the present day. It is, therefore, unnecessary to do more than call attention to some special points in the report.

Velocity of Flow—For self-cleaning velocities [ideal] gradients should not be less than 2 ft. per sec. for separate and 2½ ft. for combined systems. Lesser gradients in order to decrease trench excavation are often used. These require more frequent flushing but otherwise give no trobule provided a smooth interior surface is secured. Well constructed, reasonably flushed sewers, taking domestic sewage only, may have velocities as low as 1 ft. per sec.

Ventilation—The omission of the house trap and ventilation through the main house riser is favored by the committee.

Trade Wastes—The following classification of trade wastes with a few words of comment may be quoted from the report, as follows:

(a) Heavy mineral solids, such as lime from glue works, dust from marble yards, etc., can form deposits in the sewers which retard the flow and reduce the carrying capacity.

(b) Gelatinous materials, hair from tanneries, grease from wool works, and similar substances, by adhering to the perimeter, increase the roughness of the interior surface and so reduce the carrying capacity.

(c) Acid wastes injure the cement joints between brickwork or pipes, or attack concrete, causing leakage and destruction of the fabric of the sewer.

(d) Liquids of high temperature may soften and injure the bituminous joints in pipe sewers used to prevent the infiltration of ground-water.

(e) The discharge of live steam, volatile liquids or inflammable gases, or the sudden emptying of vats of hot water, cause a serious menace to men working on the sewers.

Trade wastes having the above properties should be strictly excluded from the sewer system, unless submitted to sufficient treatment to remove the objectionable characteristics, as, for instance, the wash-water from garages contains gasoline, which can be easily removed by passage through an intercepting tank, as required in London.

In regard to the admission of other trade wastes, it may be said that it is cheaper to dispose of manufacturing wastes in combination with the sewage than separately, and sometimes purification is only made possible by admixture with the sewage. Generally, it is good civic policy to aid manufacturing interests by providing an outlet for the liquid wastes, but obviously, since there is no greater obligation on the part of the community to take care of liquid than of solid manufacturing refuse, the power should be given those in authority to levy special assessments, based on some logical expression of the increased cost of maintaining the sewerage systems caused by the entrance of these wastes. Further, it is evident that in many cases preliminary treatment of the manufacturing wastes must be required, and none should be admitted which will injure the sewer, increase the cost of maintenance beyond that involved in independent disposal, or prejudically affect the treatment of sewage.

Finance and Assessments—In discussing the methods of raising money to pay for sewerage systems, the committee suggested the cost should be distributed "in proportion to the benefits conferred" in accordance with the following plan:

Thus, if a small part of the total expense is met by a general levy on all property to express the sanitary betterment to the entire community, a larger part is raised by assessment on property abutting on streets where sewers are built, whether those sewers are used or not, and a still larger part is obtained by rentals for actual use, the relative benefits will be fairly indicated, and the opposition to the improvement by those not particularly in need of sewers may be thus removed.

Methods of Treatment—As regards sewage disposal and methods of treatment, the committee, as might be expected, gave expression to the very sensible view that is now generally accepted by engineers to the effect that the kind and degree of treatment should be governed entirely by local conditions, taking into account the whole drainage area of the stream and the use to which the water of the stream below the point of discharge of sewage effluent is put. The summing up under this heading may be quoted from the report as follows:

(1) Sewage, or effluent from treatment works, must continue to be discharged in increasing quantities into running waterways and tidal estuaries.

(2) The establishment and maintenance of conditions offensive to the æsthetic senses through such discharge of sewage must be guarded against.

(3) Where sewage is treated so that upon its discharge into the rivers and tidal estuaries no offensive conditions are set up as regards objectionable appearance and odors, and no undue load is placed upon the water filters within the influence of the sewage discharged, and where a suitable margin of safety is allowed; the problem of sewage disposal, broadly speaking, has been solved.

With few exceptions, all sewage should receive some form of treatment, in order that offenses shall not result. These refer, first, to overtaxing the digesting or oxidizing power of the diluting stream; second, to the formation of sludge deposits on the bed and banks of the stream, these deposits putrefying later and setting up and maintaining offensive conditions; and, third, the presence of floating material and oily sleek.

*The reports and paper will be published in the "Journal" of the association.

Omitting from the problem of sewage disposal the influence on water-supplies, it may be said that, with sufficient dilution and adequate velocities, screening to remove floating matter is the minimum degree of treatment required in any case. Usually, however, it is necessary to go further and remove the heavy suspended matter, leaving only that which is light enough not to deposit in the stream, and if the flow of the stream is sufficient to dilute the clarified sewage and prevent offense, the problem is solved.

FISH AND SHELLFISH INDUSTRY—Regarding the fish and shellfish industry, the committee said:

The fish industry is not usually affected in moderately polluted waters, unless certain trade wastes are present to taint the flesh with tastes, or poison the fish. The amount of pollution must be carefully studied, as well as the minimum oxygen content to determine whether the environment is favorable. Fish are usually eaten after thorough cooking.

With shellfish, which in numerous instances are consumed uncooked, it is different, inasmuch as it is not feasible to render sewage innocuous by itself, dangerous bacterial contamination of shellfish grown in grossly polluted waters cannot be prevented. And generally the value of shellfish industries is of far less importance than the comfort and convenience of cities and towns which are forced by circumstances beyond their control to use running water for the disposal of their sewage.

The conservation of the shellfish industry in polluted waters may be aided by the sterilization of sewage before discharge therein, but shellfish should not be harvested or marketed from water exposed to sewage pollution except in such localities where properly instituted technical authorities shall determine the origin of pollution to be sufficiently remote from the shellfish beds to avoid contamination.

SKILLED SUPERVISION—Particular emphasis is laid in the report upon the necessity of skilled supervision of sewage-treatment works and of either state or Federal control of the operation of these works.

LABORATORY CONTROL—The value and importance of laboratories as aids or guides in the operation of sewage-treatment works is discussed by the committee near the close of its report as follows:

LABORATORY CONTROL

The operation of a sewage-treatment works is usually controlled by laboratory observations.

The methods generally used are largely adapted from the sanitary examination of water, and in many ways this work could be simplified.

What the operating engineer needs to know is whether each part of the works is being operated at its maximum efficiency, and whether the final effluent is suitable for discharge into the stream to maintain the standard set for that stream. For purposes of comparison with other cities more complete analyses are often desired of the crude sewage and of effluents. For instance, in the operation of a grit chamber the only important observation is the percentage of the dry residue which is organic, for if it is too high the velocity of flow through the grit chamber should be increased.

In the operation of a percolating filter it is most important to know whether the filter is delivering a stable effluent, and the storage and unloading of the suspended matter.

The most important facts required on sewage or effluent are the amount of settling material contained, the avidity for oxygen, and possibly the prevalence of pathogenic organisms.

The methylene blue test for stability marked a considerable advance, but even this has its limitations owing to the need of more extended data. Perhaps if natural conditions could be more nearly imitated the results would be more valuable. Small sample bottles, incubated airtight, afford quite different conditions from those existing in a normal stream with its constant absorption of oxygen from the air and the addition of oxygen liberated from green plants in the water.

Tests which show the results of the biological activity in the exhaustion of available oxygen in the sample tell more clearly the fitness for an effluent to be discharged than the quantitative chemical analyses of the sample.

FUTURE STUDIES—Finally, the committee suggests these recommendations for future work of the committee:

The Council, in appointing this committee, asked that it should make recommendations for special fields for committee work.

In accordance therewith, it is recommended that a committee of the Vital Statistics Section and the Sanitary Engineering Section be appointed to make investigations report upon the effect upon the death rate attributable to introduction of a system of sewers.

Also the relative efficiency in the protection of the public health by the filtration of water and by the treatment of sewage as measured by the death rate from water-borne diseases.

That a joint committee of the Laboratory Section and the Sanitary Engineering Section be appointed to make investigations and report upon standard methods for the operation and supervision of sewage disposal works.

## PAPER ON SHELLFISH CONSERVATION AND SEWAGE DISPOSAL

A paper with this title, by George A. Johnson, of New York City (a member of the Committee just noted) first reviewed in a brief and interesting way the possible dangers to public health from shellfish. It was pointed out that the total annual output of the shellfish industry in the United States is now some 40,000,000 bu., valued at about $20,000,000. Of this, nearly three-fourths is "controlled by New York, Virginia, Connecticut, Maryland, New Jersey, Rhode Island, Louisiana and Massachusetts. In discussing how shellfish grounds may be protected from sewage pollution without putting an undue burden upon municipalities, Mr. Johnson said:

Until the dream of the idealist is realized, and all sewage is made innocuous before discharge there seems to be little hope that shellfish, where usually cultivated, are not to be considered to be and still remain a potentially dangerous article of diet for human consumption unless perhaps, after being harvested, they are removed to an unpolluted water and there allowed a period for self purging before being placed on the market. It seems to be reasonably certain that polluted shellfish when placed in constantly changing, unpolluted water, will purge themselves of impurities in from one to two weeks. This department of oyster cultivation and harvesting has received altogether too little attention in the past.

This refinement in the preparation of shellfish for the market may not be the ultimate answer to the problem, but it deserves exhaustive study. If the results of such studies prove favorable there should not be a sensible oysterman who would not gladly adopt it for with the coöperation of a supervising Federal or state authority he would then be enabled to furnish for the market certified shell fish, and the thinking consumer could never object, but rather should heartily approve, of an increase in the selling price sufficient to cover the cost of such treatment, being assured of the purity of the food he is consuming.

Until prohibited by Federal or state authorities shellfish, polluted and clean, will continue to appear on the table, and even if forbidden for public sale, they will still be used. Except in special well adapted cases it is impossible on financial and other grounds absolutely to conserve the purity of shellfish by sewage treatment. Complete treatment of the sewage entering waters which flow over shellfish layings will improve existing conditions, and in special cases almost, if indeed not entirely, remove the existing danger, but to be thoroughly effective a condition is required, which is seldom, if ever, found at sewage-treatment works today. There would be required not only extreme conscientiousness in the operation of the sewage-treatment works, paralleling the vigilance with which good water-filtration works are watched, but also interstate coöperation, the whole order of affairs being supervised by a supreme authority vested by law with power to approve or condemn.

The conservation of the shellfish industry is a difficult problem, made so by the fact that common-law rights of sewage disposal into the sea and its estuaries have been and are being extensively utilized. To set these conditions back a century solely for the sake of conserving the oyster industry, where no other offense is created, is a matter which, if pressed, will engage active sanitary, financial and legal minds for many years to come.

## REPORT OF THE COMMITTEE ON RIVER CLEANING

The members of this committee are Geo. C. Whipple, chairman, Paul Hansen, secretary, Andrew J. Provost,

Theodore Horton and Harrison P. Eddy. The committee stated that since the problems which it has to study have so many phases and require data which can only be obtained by detailed investigations made by municipal, state and national authorities, the most the committee can be expected to do is to coöperate in such investigations and to try to "crystallize the results as they become available from time to time." The committee also stated in passing that its title, River Cleaning, does not seem to be well chosen, and it therefore proposes to substitute "Sanitary Control of Waterways" hereafter.

After outlining the various viewpoints from which the pollution of waterways may be considered, the committee stated that much of the confusion regarding water pollution which now prevails "in the popular mind, and even in the minds of sanitarians, results from failure to appreciate the impracticability of applying the same standards to all waterways." The committee then proceeded to take up various viewpoints as follows:

(1) Where the only thing necessary to do is to prevent nuisance "no greater requirement need be made than that the water be non-putrescible, free from unsightly color and suspended or floating matter, and that no sludge banks or other objectionable deposits be formed." Standards for use in this connection based on the oxygen-absorbing powers of the water have recently been proposed by the Royal Commission on Sewage Disposal (British) and by the Metropolitan Sewerage Commission of New York City.

(2) Where public water-supplies are involved the standard ought not to rest upon analysis alone, but upon the sanitary conditions of the watershed and the knowledge of the stream in general.

On the important subject of stream pollution in relation to water-supply we quote from the report in full as follows:

(2) The permissible degree of waterway pollution where such waterways are used as sources of public water-supply is very difficult to determine, yet there is apparently a need for some such standard, even though it be a somewhat arbitrary one.

When such a standard is established it ought obviously to rest not upon analyses alone, but quite as much upon the sanitary conditions of the watershed as revealed by inspection, upon knowledge of stream flow at high and low water, the population and industries tributary to the sewers, the distance of pollution above the water-works intake, and the like. In other words, some index must be obtained of the danger of infection. Nor must the æsthetic sense of the community be offended by using water obviously foul.

Your committee regrets that it cannot present at this time a suitable index to be used as a standard for waterways that come within this grouping.

(3) In water used for recreation purposes "esthetic considerations must play a predominant part." There should be no evidence of sewage to the eye or nose, and if the water is to be used for bathing purposes untreated sewage should not be admitted "except at points so remote that self-purification is assured at all stages of the water."

(4) Where fish are involved "the permissible degree of pollution in a waterway is an essentially economic proposition, to be decided after a comparison of the damage done or expected, and the cost of preventing the damage." Experiments are needed to determine the quantities of oxygen needed to support fish life.

The greatest danger to shellfish arises "from comparatively small quantities of polluting matter not perceptible to the unaided senses, and here rather delicate methods of bacterial analysis are needed to indicate the danger." Studies of plankton are needed in connection with both fish and shellfish in relation to sewage treatment since each is dependent largely upon plankton for food.

(5) The danger of sewage pollution to cattle "should also be regarded as one to be settled upon economic grounds." Anthrax is "about the only specific disease" involved, and this is very rare in the United States. More data are needed to determine the dangers to cattle from polluted waterways.

(6) The measure of injury to industries by water pollution is also an economic one.

(7) Sludge banks must be given some consideration, although only rarely to the results from sewage disposal proper, being found more frequently in connection with various sluicing operations. The report states that "sludge may result from undue restriction of waterways by heavy deposits of waste."

(8) Polluted water when used in irrigation may give rise to offensive odors if it lies upon the irrigated fields. There is also a "somewhat remote danger" of pollution of fruits and vegetables eaten raw after having come in contact with polluted irrigating water. Under ordinary conditions all that it is required for irrigation waters in the way of regulation of pollution is "a condition of stability." This subject, however, needs further study.

The concluding portion of the report is as follows:

It will be noted that in the foregoing discussion comparatively little emphasis has been placed upon the relation of waterway pollution and public health, but that much stress has been placed on the economic phase of waterway sanitation, and it is important that this phase be most fully recognized. As a mere matter of civic cleanliness and public decency public places and public waterways should be kept in a reasonably clean condition, but in approaching the solution of any problem involving waterway sanitation the question should invariably be asked, "what is the value of the benefits derived as compared with the cost of maintaining the stream in an acceptably clean condition?"

Broad generalizing must be avoided, for nearly every waterway is a law unto itself, varying in its remoteness from public view, in its variations between high and low water, in the accessibility of its banks, in the uses to which it may be put, and the physical condition of the water in its normal state and in other ways.

The legal control of stream pollution and the sanitation of waterways varies greatly in the different states. In order to exhibit these differences and at the same time to ascertain their relative usefulness the committee has invited the engineers of a large number of state departments of health to present brief papers discussing the operation of the laws in their several states. And the committee wishes to take this occasion to thank those who have so kindly accepted this invitation.

We hope that these presentations will form the nucleus of a more detailed compendium of existing state laws on the subject of streams pollution, to be prepared during the coming year, should the section see fit to ask the committee to continue its work.

⁂

**The Prevention of Corrosion** of iron in acid waters with an electrolytic method is proposed by the U. S. Bureau of Mines, which has made experiments with iron submerged in sulphuric-acid solutions. The metal structure to be protected is to be made the cathode of the circuit, that is, current flows from the water to it. The current density and the actual current required for protection can be calculated from experimental data on the loss in weight of the metal when unprotected under the given conditions reproduced as near as possible. This loss in weight per hour per unit area, divided by the electrochemical equivalent (weight dissolved or deposited per ampere-hour) gives the current density to be employed. This multiplied by the actual area to be protected gives the actual current needed. It is obvious that for good protection, the anodes, by which current is led into the water, should be distributed as much as possible so that the current may not return to the protected structure at one point only.

# The Elkhorn Railway Extension

By O. K. Morgan*

*SYNOPSIS—The railway extension described in this article is the final link in a new route from the Ohio River valley to the manufacturing districts and ports of the South Atlantic states. It has a continual ascending grade from a valley bottom to a mountain summit. It is essentially a tunnel line, having no less than 21 tunnels (the longest 7804 ft.), while there are only eight bridges, the policy of the location being to pierce the mountain spurs rather than to span the ravines. Some heavy construction work was included on this line, and the article describes both the characteristics of the line and the methods of construction.*

The original conception of the Carolina, Clinchfield & Ohio Ry. embodied a line extending from Elkhorn City, Ky., the terminus of the Big Sandy Division of the Chesapeake & Ohio Ry., southward to Spartanburg, S. C., which is a railway center, with lines to Atlantic coast ports. For various reasons, however, the construction of the line between Elkhorn City and a point about 35 miles south (known as Dante, Va.) was not undertaken at the same time that the remainder of the line was constructed in 1906, 1907 and 1908. The railway was described in Engineering News, Jan. 21 and June 10, 1909.

In May, 1912, it was decided to construct the Elk... Extension, or the northern portion of the line, abo... miles long, to its connection with the Chesapeake & ... Ry. Its completion will give a short rail route fro... Ohio Valley to the Carolinas and the south Atlanti... board, and will effect a considerable saving in dist... and time between many of the prominent comme... points in each of these territories, as may be seen by ... smaller map in Fig. 1. This extension also, will ope... a large undeveloped territory rich in timber, coal ... other minerals for practically its entire length. Th... general conditions are shown by the map and profi... Figs. 1 and 2.

The town of Dante, Va., lies at an elevation of 1760 ft. above sea level. It is on the south slope and in one

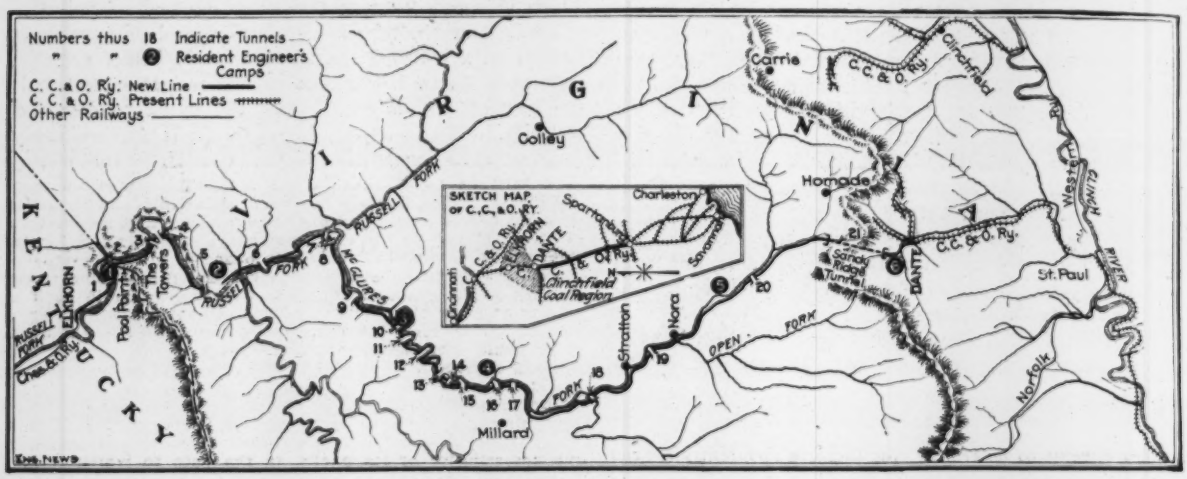



Fig. 1. Map of the Elkhorn Extension of the Carolina, Clinchfield & Ohio Ry. (with Small-Scale Map of the C., C. & O. Ry.)

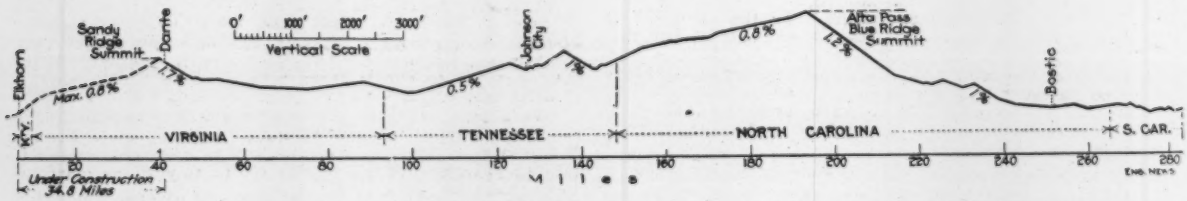



Fig. 2. Profile of the Carolina, Clinchfield & Ohio Ry., Including the Elkhorn Extension

The problem of passing Sandy Ridge by a satisfactory line was the most serious one encountered in building this connecting link, and engaged the attention of the

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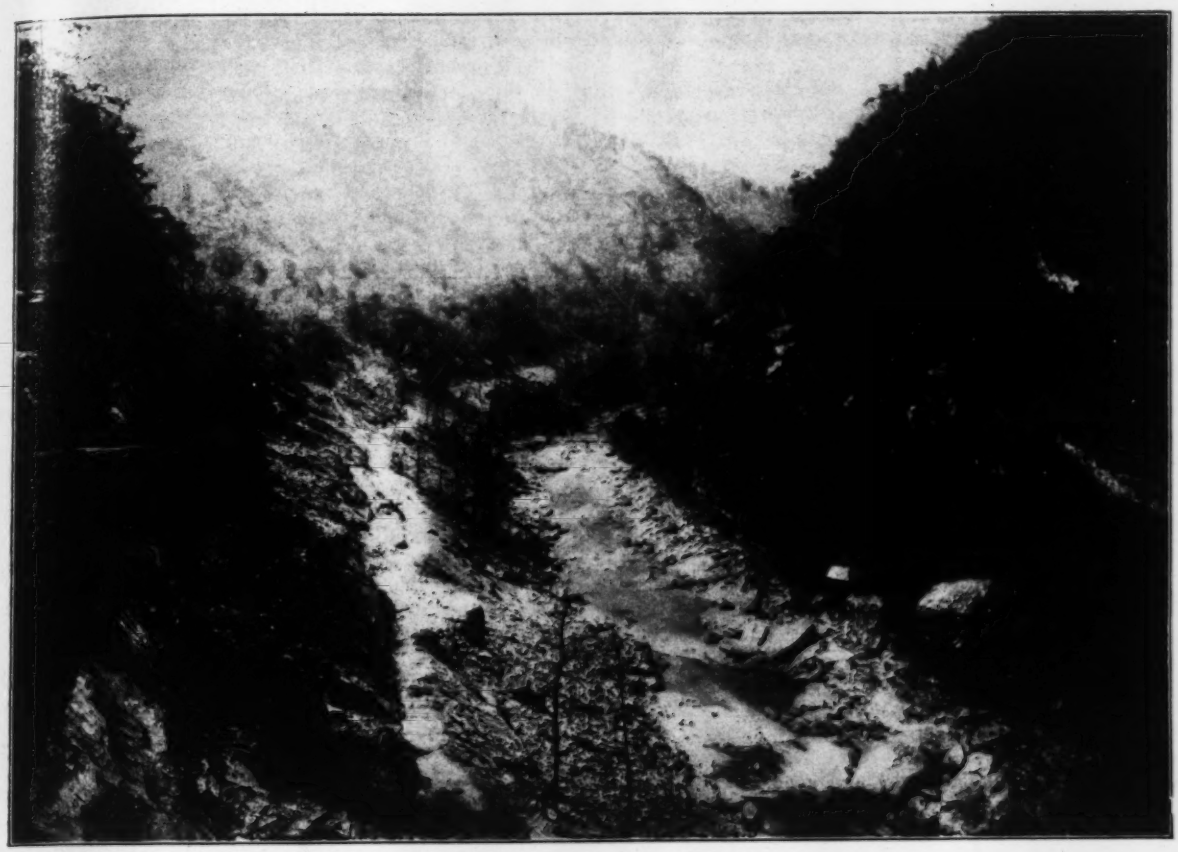

FIG. 3. RAILWAY CONSTRUCTION THROUGH "THE BREAKS" IN THE PINE MOUNTAIN RANGE (CUMBERLAND MOUNTAINS); KENTUCKY-VIRGINIA

engineers from time to time for a period of seven years. This study resulted in the final adoption of the present plan, calling for a tunnel 7804 ft. long.

After passing Sandy Ridge going north, the line follows the valley of McClure Fork (a tortuous mountain stream) for a distance of 21 miles. Thence it follows the valley of Russell Fork for 11 miles to Elkhorn City. Russell Fork is a tributary of the Big Sandy River, which breaks through the Pine range of the Cumberland mountains by a deep, tortuous, rocky gorge known as "The Breaks." This region is notable in Kentucky, Virginia and West Virginia for its general inaccessibility from the outside world. The character of the country is indicated by the accompanying views. Fig. 3 is a view in "The Breaks," between "The Towers" and the State Line tunnel (No. 2). Fig. 4 shows the roadbed beyond the Pool Point tunnel (No. 1), looking north from the ridge above the north portal of the tunnel.

### CONSTRUCTION WORK

The difficulties of construction of this line are those usually attendant upon building a 10° line in a 20° country, which means either many tunnels or many stream crossings. On account of the difficulty of getting in supplies, as well as considerations of future maintenance and satisfactory grades, it was decided to make a free use of tunnels and eliminate as much bridging of streams as possible. For this reason, while there are

FIG. 4. ROADBED NORTH OF POOL-POINT TUNNEL, ALONG RUSSELL FORK, IN KENTUCKY

(The lower right-hand corner of the view is over the portal of the tunnel.)

only eight bridges (with an aggregate length of 2125 ft.), there are 20 tunnels with a total length of 20,531 ft.

The line in general lies on the steep mountain slopes, well above the stream bed. The work is heavy, about 70% of the grading being solid rock. About 3,000,000

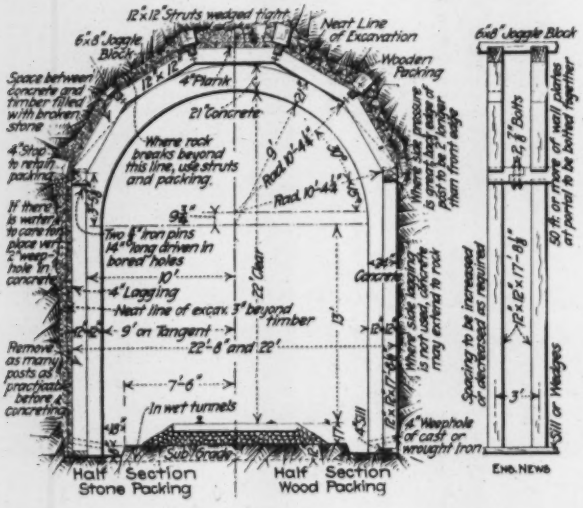


FIG. 5. STANDARD TUNNEL SECTION; CAROLINA, CLINCHFIELD & OHIO RY.

cu.yd. of grading and 26,000 cu.yd. of masonry are required. The work has no unusual features, except those due to the rough topography and generally inaccessible nature of the country. These conditions increase the difficulties of getting in supplies and keeping labor, and required the building of new roads. The labor trouble seems perennial with all jobs remote from the big centers of population.

There are eight steam shovels on this outside work (exclusive of those in the tunnels). Several of the cuts exceed 50,000 yd. One fill has 180,000 yd. and is 90 ft. high; another has 154,000 yd. and is 95 ft. high. Viaducts were originally contemplated for these, but fills were decided upon later.

Construction was started in June, 1912, and it is expected that the line will be completed early in 1914. The Sandy Ridge tunnel is the controlling point which determines the time required for completing the line.

### CURVES AND GRADES

The maximum curve is 10°, and 10° curves are rather numerous, due to the configuration of the country. The average curvature is 6° 26′ and the total curvature 6339°. The percentage of tangent in the line is 45.7%, which is high for this sort of country. All curves of 3° and over have transition curves (Talbot's system), and all curves on grades are compensated at the rate of 0.035% per degree of curve.

The grades are all ascending southward from Elkhorn City to the southern end of the Sandy Ridge tunnel, beyond which there is a descent for a short distance to the connection with the present line at Dante (Fig. 2). The grades are approximately as follows, starting at the Elkhorn end, and all are compensated for curvature: 7 mi. with a maximum of 1.5%, 19 mi. with a maximum of 0.8%, 6 mi. of 1%, 1½ mi. of 0.5% through the Sandy Ridge tunnel, and finally 1.3 [illegible] of 1.8% descending grade into Dante.

It is probable the heavier traffic will be southb[illegible] and the 1.5% grade near Elkhorn and the 1% [illegible] up to the Sandy Ridge tunnel will be operated by [illegible] ers. The total ascents are 1046 ft. and total de[illegible] 76 ft. Much attention was given to the matter of [illegible] ient and it is believed these grades give the best oper[illegible] conditions obtainable for a line of this cost, which [illegible] be approximately $5,000,000. The train loads wil[illegible] proximate 2700 tons, hauled by a single Mallet lo[illegible] tive of 72,300 lb. tractive power, assisted on the p[illegible] grades by a 2:8:0 locomotive of 40,000-lb. tra[illegible] power.

### TUNNELS

The standard tunnel section of the C., C. & O. Ry. is shown in Fig. 5. It is 18 ft. wide and 22 ft. high in the clear, after lining is in place, and gives ample space overhead for smoke and ventilation, as well as ample side clearance. Fig. 6 shows the south end of the Pool Point tunnel (No. 1), and immediately in front of it is the form for the abutment of the bridge which will carry the line across the river. The same condition exists at the Skagg's Hole tunnel (No. 5), except that this tunnel is not so high above the water.

All except two of the tunnels are being driven by the common method of first excavating the heading and then

FIG. 6. SOUTH END OF THE POOL-POINT TUNNEL, AND NORTH ABUTMENT OF THE POOL-POINT BRIDGE (115 FT. ABOVE THE WATER LEVEL OF RUSSELL FORK)

the bench. The two exceptions are where the material is such as to require immediate placing of a timber lining, in which case the bench is kept close up. A steam shovel is being used to take out the bench of those known as the Goff, Red Ridge and Sykes tunnels. For the lined section of tunnel, the approximate quantities per lin. ft.

of tunnel are as follows: net excavation (to 3 in. outside of timbering), 21.7 cu.yd.; concrete lining, 4.61 cu.yd.; timbering, 600 ft. b.m. In wet tunnels, the engineer may require the bottom to be excavated 1 ft. below subgrade, for which the contractor is allowed 0.66 cu.yd. per lin. ft. of tunnel.

While nothing has been done toward lining any of the tunnels of this extension, the methods used will probably be similar to those used for the past three years on the present operated line. The concrete is mixed by a machine at a plant conveniently placed near one portal and is deposited by gravity in the specially equipped scaffold-car shown in Fig. 7.

This car is hauled by a cable attached to the drum of a hoisting engine, being moved in and out of the tunnel to and from a temporary siding. From the various decks of this car the concrete is shoveled into place. Wooden forms are used. The method has proved very economical and satisfactory.

The width of tunnel on curves is shown in the following table, which gives also the superelevation and speed allowed. The total width in any case is 18 ft.

| Curve Deg. | Width of tunnel on curves: Inside curve Ft. | Outside curve Ft. | Superelevation In. | Speed m.p.h. |
|---|---|---|---|---|
| 1 | 9.14 | 8.86 | 1 | 45 |
| 2 | 9.26 | 8.74 | 1½ | 36 |
| 3 | 9.35 | 8.65 | 2½ | 35 |
| 4 | 9.42 | 8.58 | 3 | 34 |
| 5 | 9.49 | 8.51 | 3½ | 33 |
| 6 | 9.56 | 8.44 | 4 | 32 |
| 7 | 9.63 | 8.37 | 4½ | 31 |
| 8 | 9.63 | 8.37 | 4½ | 29 |
| 9 | 9.63 | 8.37 | 4½ | 27 |
| 10 | 9.63 | 8.37 | 4½ | 26 |

### Sandy Ridge Tunnel

The construction of this tunnel governs the time required for the completion of the line, as explained above. Consequently, every effort was made to get this under way first. The contractors immediately put two large steam shovels at work on the south approach cut, which contained 70,000 yd.; and as soon as a shovel could be got across the mountain, work was begun on the north approach cut, containing 55,000 yd. The south heading was started in the middle of October and the north heading the middle of November, 1912. The present rate of progress is about 100 ft. per week for both ends, heading and bench being driven close together.

The tunnel is being driven from each end, no shafts being used. The method of driving is as follows: the heading is driven about 12 ft. in advance of a sub-bench, which in turn is about 10 ft. in advance of the bottom bench, and all are shot together. Drilling is done by 3¾-in. Ingersoll-Rand drills operated by compressed air. Mucking is done by Marion shovels, also operated by compressed air, the machines being equipped with air receivers instead of boilers. These shovels are fitted with 1½-yd. special rock buckets.

Compressed air is furnished from two plants, one near each end of the tunnel, and each equipped with an Ingersoll-Rand compressor with a capacity of 1800 cu.ft. of free air per minute. The compressor is belt-connected to a 300-hp. electric motor receiving current from a private power plant. The current is 6600 volts and passes to a transformer at the compressor plant, which delivers it to the motor at 2300 volts. From the compressor the air goes to a receiver 54 in. diam. and 12 ft. long, thence by an 8-in. pipe line to the tunnel portal. At this point it reduces to a 6-in. line for a distance of 1000 ft., then it is further reduced to a 5-in. line, and carried to the drills and to the air receiver on the power shovel.

Haulage of the muck is done by two electric locomotives at each end of tunnel, handling 4-yd. dump cars. The locomotives at the north end are each of 5 tons weight; at the south end there is one of 5 tons and one of 6 tons. They all receive 250-volt direct-current from a No. 00 wire of figure 8 section, current being generated by a 125-hp. motor at each compressor station.

To expedite ventilation, which during certain weather conditions is poor, there has been installed at the south end a fan, driven by a 20-hp., 2300-volt motor. The displacement of the fan is 2500 cu.ft. of air per minute, which is drawn from the tunnel through an air line of

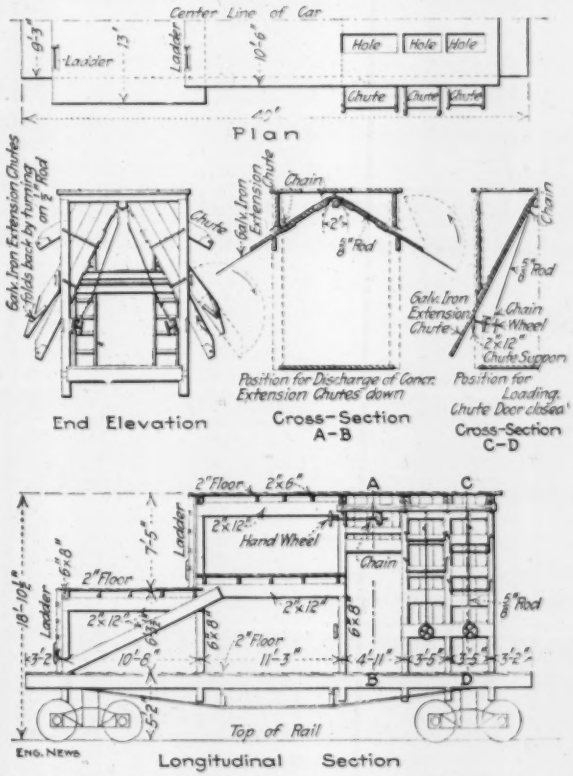


Fig. 7. Concrete Car for Delivering Concrete to the Forms for the Tunnel Lining; C., C. & O. Ry.

galvanized sheet iron 14 in. diameter. A ventilating plant will soon be installed at the north end of the tunnel. The tunnel is lighted by electricity on a 220-volt circuit, from a small transformer located at the compressor plant.

At present the force is being worked in two 10-hr. shifts, except Sundays. At the south end, the material is gray slate with sandstone roof. At the north end, it is gray sandstone with seams and some slate on the bottom. It is probable that a portion of the tunnel will need lining.

### Bridges

Seven of the eight bridges have deck plate-girder spans, and there is only one truss span. The substructure work is of concrete, and Fig. 8 shows the two abutments and four piers for the Open Fork bridge at Nora,

Va. This has three girder spans of 70 ft., with a height of 40 ft. from low-water level to the rails. All the bridges are designed for the E-60 loading of Cooper's specifications. When a bridge occurs at a curve, the

FIG. 8. CONCRETE PIERS AND ABUTMENTS OF THE OPEN CREEK BRIDGE, NORA, VA.; C., C. & O. RY.
(The view shows the temporary trestles used in building the approach embankments.)

span is tilted by varying the height of the shoes, thus securing the proper superelevation of the track without placing corbels under the ties.

The truss span is in the bridge crossing Russell Fork at Pool Point, two miles from Elkhorn City. The site of this (immediately south of the tunnel) is shown in Fig. 6. The bridge crosses the river over a pool 50 ft. deep, and is 115 ft. above the water. During freshets this pool becomes a veritable whirlpool, and unusual precautions in the erection of this bridge are necessary, as floods are liable to occur at any season of the year. It was finally decided by the bridge company having the contract, to erect the truss span by means of a temporary steel falsework of A-frame construction.

This bridge has a deck span of 270 ft., with a girder span of 50 ft. at one end and 70 ft. at the other, as shown

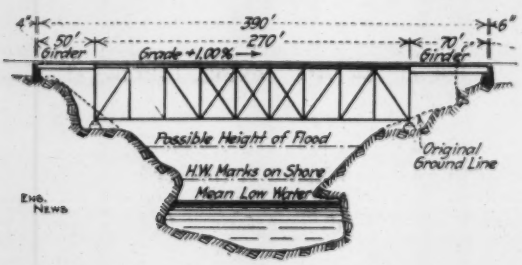


FIG. 9. THE POOL-POINT BRIDGE, CAROLINA, CLINCHFIELD & OHIO RY.

in Fig. 9. It is on a grade of 1%, and at its lower end is the spiral or transition curve of a 7° curve. It will be seen that the masonry consists merely of four small pedestals for the truss seats and two small abutments. The pedestals are 8x8 ft. on top, with sides battering 3:12. They are reinforced near the top by two layers of ¾-in. bars, the bars being wired together and having the ends bent down vertically about 9 in. The concrete is a 1:2:5 mixture for the abutments and 1:2: the pedestals and the bridge seats on the abutment north abutment is only 50 ft. from the tunnel

### ROADBED AND TRACK

The roadbed is being constructed 22 ft. wide in 20 ft. in rock, and 18 ft. on embankments, in accor with the sections shown by Fig. 10. The ditche made exceptionally wide to accommodate the

FIG. 11. RESIDENT ENGINEER'S HEADQUARTERS NEAR MILLARD, VA. (RESIDENCY NO. 4); C., C. & O. RY.
(When the line is opened these buildings will be occupied by the section foremen and section gangs.)

ditcher, which this road uses in maintaining its ditches. The track will be laid with 85-lb. openhearth steel rails of the Am. Soc. C. E. section, in 33-ft. lengths, with Bonzano joints, ⅞-in. Harvey grip bolts and 2880 ties per mile. Passing sidings with a clear length of 4000 ft. are provided at intervals of about 7 miles.

The engineers' quarters of residency No. 4, near Millard, Va., are shown in Fig. 11, and this is typical of the character of the buildings constructed. These buildings will be used by the section foremen and gangs after

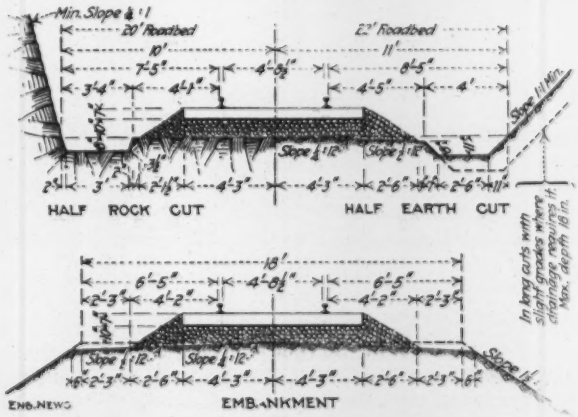


FIG. 10. ROADBED CROSS-SECTIONS OF THE CAROLINA, CLINCHFIELD & OHIO RY.

the completion of the line. Each building is 23½x29½ ft. in plan and has four rooms, with a covered porch along the front and at the rear.

### ENGINEERS AND CONTRACTORS

All location and construction work are under the direction of Ward Crosby, Chief Engineer of the Carolina, Clinchfield & Ohio Ry. The writer is office engineer,

and the construction work is divided between six resident engineers. The Rinehart & Dennis Co. has the general contract for grading and masonry, and the American Bridge Co. has the contract for all bridge work.

# Unsurfaced Roads*

By W. S. Keller†

Two million one hundred thousand miles of roads in the United States are unsurfaced or rather have not been resurfaced by the hand of man. Until within recent years it was considered next to impossible to make a good road of ordinary earth without surfacing with stone, gravel or other hard material. The absence of suitable material in vast sections of the country and the high cost of it when handled by railroads have forced attention to earth or unsurfaced roads.

Unsurfaced roads may be divided into three classes:

First, the ordinary country road opened when this country was young, leading from one settlement to another or from a farmer's home to that of his nearest neighbor. We have many roads in Alabama now in use that were opened and traveled by General Andrew Jackson, both on his march to fight the British at New Orleans and the Indians in south Alabama and Florida. Of course, such roads were opened hurriedly and little or no attention was given to grades or alignment. In the construction now of more modern roads, it is difficult to better the alignment of these roads on account of homes, churches and schools which have been built close to these highways. However, in many places, these roads have been and are being changed to meet the demand of traffic of today. The genuine bad roads of the South belong solely to this class. The great amount of work necessary to keep them is passable condition disheartens the man who by law is compelled to work them. Until these roads are re-located, avoiding heavy grades and marshy bottoms, sharp angles and useless twists and graded so that they will have good drainage, we may expect them to be bad.

The second class of unsurfaced roads are the ordinary graded earth roads which have proper alignment, grade and drainage. The construction of an earth road is simple, but sometimes the simplicity of it causes the average county commissioner or supervisor to overestimate his ability as a road builder. The proper construction of an earth road consists of first: A careful inspection by the proper official to determine what beneficial changes in grade and alignment can be made, taking into consideration initial cost and cost of maintenance. The center line and grade of the road should be established by an engineer. After the center line has been established and width of roadbed agreed on and grade established, construction work can begin.

The proper and efficient grading force for the work should consist of a foreman, eight or ten good two-horse teams with drivers, one wheel and one drag scraper for horse teams with drivers, one wheel and one drag scraper for each team and one extra wheeler and drag for emergencies, one good railroad grading plow, one grading machine, one split-log drag, one dump man and one loader with five or six extra men for grubbing and other work. The foreman should be an experienced grading man who understands handling earth and knows when it is proper to use drag scrapers, wheel scrapers or wagons.

The road should be so graded that the ditches or gutters are parallel with the center line of the road and a uniform distance from it. When completed the road should be uniform in width and surface should be smooth and even, free from holes and high places with a uniform crown with a fall of one inch to one foot from center to gutters. On grades this ratio of fall should exceed that of the grade to such an extent that water will readily flow to the ditches instead of down the road. Drain pipe should be freely used and no water should be allowed to flow over the road if it can be avoided.

We have in the South nearly every kind of soil from sticky gumbo on the one hand to coarse sand on the other. The methods used for improvement of roads through a section of one will not do altogether for the other. The worst roads by far that we have in the South are in our rich and fertile prairie lands where, unfortunately, there is very little road building material to be found. This soil readily absorbs water and becomes very sticky after rains. It expands freely and dries rapidly when the sun shines and becomes very hard under the tamping effect of teams and vehicles. From observation and experience I have learned that these roads of all others require a very high crown and the driving surface should only be wide enough to allow two vehicles to pass. If a road is narrow with a fall of not less than 1½ in. to the foot, water will shed rapidly to the ditches and the entire surface will dry out rapidly. A road of this kind can be constructed quickly and at little expense with a grading machine, or even with a split-log drag. The latter method will require more time, but in the end will be found to be very satisfactory. No earth road can be maintained in good condition unless it is so constructed as to drain well and unless it is kept free from ruts and holes.

The third class of unsurfaced road which we frequently have to deal with are those in sections of country where the soil or earth is really road building material, composed either of gravel, sand-clay or top soil so that when the road is graded it is, in fact, surfaced. Where this condition exists, splendid roads can be built at a minimum cost.

The maintenance of unsurfaced roads is radically different from the maintenance of surfaced roads. One man with a team and drag should be able to keep in good condition 20 miles of ordinary graded earth road. It has been difficult to convince county authorities in the South that this little machine is of value.

The writer when in charge of road work in a Tennessee County inaugurated a system of dragging that proved very successful. Ten roads were graded a distance of three miles each. The grading was completed in November. With the surface of these roads fresh and loose, it was a foregone conclusion that the winter rains would soften them to the extent that they would become impassable under heavy traffic. Contracts were made with a farmer on each of these roads to keep them dragged during the months of December, January, February and March and the price paid was 30c. an hour for a man and team. The county furnished the drags. As an inducement to the men to do good work, the county offered prizes of $25, $15 and $10 for the best kept roads. Specifications for dragging and rules governing the contest were furnished each contestant. One important rule was that the prizes would be awarded to the men who kept their roads in the best condition at the least cost. In order that the engineer might keep in close touch with the work, postal report cards were furnished each man and they were required to fill them out every Monday showing the distance dragged, hours consumed and cost for the previous week and mail them to the office of the engineer. In this way it was practically impossible for a dishonest man to render an account for more time than he really consumed without it being detected or if he worked more than was necessary, the reports of the other contestants when compared with his disclosed it. On the other hand if one should be neglecting his work by not dragging sufficiently it was likewise detected. This 30 miles of road was kept in splendid condition despite the fact that two heavy snows fell during the four months. The most interesting fact connected with the contest was the road that was awarded first prize cost the county only $15, or $5 per mile, for the winter.

In many Southern States the roads are maintained or at least are supposed to be, by what is known as statute labor, which means a man subject to road tax may work out his tax under the direction of a "beat" or district overseer. Such labor is practically worthless and few men are required to work out the stipulated number of days. As it seems to be impossible to entirely abolish statute labor, the question that confronts us now is, What is the best system coupled with this labor to use in the maintenance of our roads? Good results have been accomplished in several counties in Alabama by putting the work in the hands of a few regularly employed foremen who give all of their time and attention to the work, instead of leaving it to many beat overseers who work when it suits their convenience, or do not work at all when it suits them, as it usually does. These foremen are furnished with two or three teams with regular drivers, wagons, scrapers and grading machines, split-log drag and necessary small tools and as many beats or districts assigned to each as he can work. A census is taken in each foreman's territory at the first of the year of all men subject to road duty and he is furnished with a list of names and is required to work every man who has not paid the required amount of cash into the County Treasury in lieu thereof. No foreman is allowed, under penalty of dismissal, to receive cash from work hands, but such hands as desire to pay must make their pavements to the proper county official at the Court House. This method has proven good in most cases, but as a general thing I do not think the best results can be accomplished by permitting men to work out their road tax.

*Paper before the American Road Congress, Detroit, Mich., Sept. 29-Oct. 4, 1913.

†State Highway Engineer of Alabama.

# The Wisconsin Water Power Law

A recent enactment of the Wisconsin Legislature (Chapter 765, Laws of 1913, known as the "Water Power Act") has put all water-power developments (existing and future) in that state under the control of the Railroad Commission, placing them practically on the same plane with public utilities in general. Such widespread interest has been manifested in the new regulations that a brief abstract of the law is given below. The sequence of topics generally follows the law, but the phraseology does not.

The commission is directed (1) to make a complete survey of the navigable waters of the state (with the assistance and coöperation of the state and Federal geological surveys when practicable), (2) to make a complete investigation of all existing dams and franchises, permits, etc., under which they are operated and to report this information to the legislature with recommendations in the public interest, (3) to survey and report on all power sites within the state whether developed or not, (5) to maintain gaging stations on all navigable waters.

No dam can hereafter be constructed unless the commission shall determine that the place is a suitable power site and that the work proposed will not interfere with any other dams authorized for river improvement. The improvement of river navigation, the construction, maintenance and use of all dams, and control of river level and flow are placed under the supervision of the commission. The commission is to determine reasonable methods of construction, equipment, maintenance and operation of any improvement, and no dam can be constructed until plans and specifications have been approved by the commission. Except in emergency (protection of life, health or property), no substantial alterations or additions can be made to any dam without an investigation and order of the commission. On complaint or on its own motion, the commission may examine any dam, structure or reservoir, and, if one is found, unsafe, it must determine what work is necessary, and it may order such work done. In cases of emergency the commission may, without notice, cause any stored water to be drawn out.

The act provides that all dams in navigable waters must conserve and protect navigability. The commission is directed to require timber slides, locks, boat hoists or marine railways, spillways or flood gates, protecting booms or piers, and benchmarks showing allowable minimum and maximum heights of water level. Every dam owner, except a municipality, must pay an annual inspection fee of 10c. per horsepower storage capacity at ordinary stages (with a minimum of $10). Corporations holding a franchise under the new law are subject to the duties and liabilities of river-improvement companies under the general law but are entitled to reasonable tolls for navigation facilities. The tolls are subject to commission regulation like public-utility rates.

No person, firm, corporation or municipality may hereafter use a dam across any navigable stream without authority of law, legislative act, or a franchise under this act. Franchises authorizing the construction, maintenance and use of dams, where not more than 250 hp. can be developed, and dams for improving navigation, may be granted to any person, firm or corporation, or to any municipality. But franchises covering sites where over 250 hp. can be developed may be granted only to corporations or municipalities.

Applicants must file a description of the power site and proposed dam, show the extent and method of navigation improvement, list all riparian owners affected, name the nearest city above and below the site, and the nearest dam existing above and below, present a large-scale map of the power site and all lands affected, state the amount of power proposed to be generated, and describe the market territory. The applicant must propose (1) fully to develop the available water power and to install such auxiliary power as the commission finds advisable, (2) to install a prescribed system of accounting and authorize the commission to audit revenues and to approve expenditures for construction, (3) to terminate contracts, not more than 30 years after the franchise date, giving the commission right then to require that power delivered to distant points be furnished to nearer points, (4) to give the state right after 30 years to collect a specific amount per horsepower developed, provided the state have constitutional power to, and shall engage in improvement of navigation, (5) to sell its property at reproduction cost to a municipality or to the state if it then have constitutional power to purchase.

On receipt of an application the commission is dire[cted] to give a public hearing advertised for three weeks. The[re] cants are required to notify every person interested in a[ny] lands. On notice of favorable action upon an appli[ca]tion articles of incorporation are to be filed with the comm[is]sion. These papers are to be approved and filed with the s[ec]retary of state. Incorporating power formerly vested in this [de]partment is transferred to the commission so far as concerns [water] power and river-improvement concerns.

A franchise will continue in force until the st[ate] or municipality exercises its option to acquire the prope[rty] in which case both corporate charter and franchise ter[mi]nate. When such property is acquired just compensation mu[st] include any value for the franchise. The law specifically denies the existence of any private property right in [water] or the use of water, and permits no state agency to pay [any] compensation for value of any power site because of water [power] or the use of water power. Property located within or without the corporate limits of a municipality may be acquired for public municipal purposes after condemnation proceedings. When a state or municipality exercises its option to purchase, it is required to give existing customers preferential rights to service; but such right shall not continue more than 10 years.

If a grantee, having a dam of less than 250-hp. capacity, desires to increase it over that figure or shall desire to couple up that with any other developed water power to complete a development of more than 250 hp., application must be made for a charter and franchise as for the larger developments. No transfer or assignment of franchise is valid unless the commission shall approve it, and no franchise can be assigned to foreign corporations. A franchise granted to a municipality cannot be assigned to any person, firm or corporation except as security for a loan, and the latter may hold title or operate only three years. No municipality may execute a lease or contract for the sale and use of power for periods longer than 15 years, and only on the approval of the commission.

If any improvement under this statute shall be owned, leased or controlled in any way so as to effect an unlawful combination or a restraint of trade in the sale of power, then the commission may take possession of the property by receivership proceedings, the members of the commission being appointed as receivers for such period as the courts may determine.

Violations of this law are punishable by forfeiture of up to $1000 for each violation. A sufficient sum is directed to be annually appropriated out of money in the treasury sufficient to carry out the provisions of the act but not to exceed $25,000.

**The Australian Circumcontinental Railway,** which is eventually to run from Kalgoorlie, in Western Australia (at which point it connects with a railway already built to the western coast at Perth) to Port Augusta, on the southern coast in South Australia, is now under construction. This line has been under discussion in Australia for many years (see "Engineering News," Jan. 5, 1905, July 30, 1908, Jan. 6, 1910). According to a note in the engineering supplement of the London "Times," the road was started during 1912, and the rails have now been laid for a distance of some 10 miles from each end. Construction had, however, been delayed, by the non-delivery of rolling stock. It is intended to use track-laying machines and other labor saving devices in the construction of the line, as considerable difficulty is anticipated in obtaining suitable labor. What there is, is very expensive. Owing to the poor nature of the country, little local traffic is expected, but there will be a large passenger and mail traffic between the eastern and western states. From the point of view of defense, according to the "Times," the railway is essential, as at present all communication between Eastern and Western Australia would be cut off if command of the sea were lost. The total length of the Transcontinental Railway will be 1063 miles. The gage is to be the standard, 4 ft. 8½ in.

The following table is given in the "Times" to show the state of railway construction in Australia at the present time.

| Name of state or country | Railways open for public traffic owned by government | Population | Miles of railway per 10,000 inhabitants |
|---|---|---|---|
| New South Wales | 3,831 | 1,737,335 | 22.06 |
| Victoria | 3,622 | 1,354,405 | 26.74 |
| Queensland | 4,266 | 633,917 | 67.30 |
| South Australia | 1,461 | 420,806 | 46.09 |
| | 478 | ..... | ..... |
| Northern Territory | 145 | 3,362 | ..... |
| Western Australia | 2,598 | 302,341 | 85.94 |
| Tasmania | 495 | 190,017 | 26.08 |
| Commonwealth of Australia | 16,899 | 4,644,239 | 36.39 |

* Port Augusta-Oodnadatta line transferred to Commonwealth.

# EDITORIALS

## Excess Condemnation to be Voted on in New York State

City engineers and many other city officials as well have often observed the embarassment and economic loss caused to cities in condemning real estate for street and other public improvements through the cities being limited to the taking of only the area required for the purpose in hand, regardless of the shape and size of either the portion of any given lot which is taken or of that which is left. As a consequence of this restriction, which is almost, if not quite, universal in the United States, our cities often have to pay the full value of a lot for only a portion of it, and sometimes a small portion at that.

In sharp contrast to this requirement, European cities are quite generally allowed to take land outside the area to be devoted to public use, and subsequently to rearrange the remaining odd-shaped parcels in accordance with a well devised plan and sell the land with suitable restrictions on the character of the buildings to be erected upon it. As a result of this foreign plan, substantial savings are effected in the cost of land, and sometimes a profit through appreciation in value due to the city improvement—that is, the city gets for itself the unearned increment which its action alone has created.

The practice of taking more land than is needed for a public improvement is known as "excess condemnation." A constitutional amendment authorizing that practice in New York State was passed by the legislatures of 1912 and 1913 and now requires only the sanction of the voters of the state at the coming election on Nov. 4. It is to be hoped that the vote will be favorable and that like constitutional amendments will be adopted in other states where like authority does not exist.

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## The Flooding of Culebra Cut on the Panama Canal

Since the most gigantic task in connection with the Panama Canal work has been the excavation of the nine-mile long Culebra cut through the Continental divide, so the most notable landmark in connection with the gradual completion of this greatest of engineering works, was without doubt the flooding of the Culebra cut excavation on Oct. 10.

As our readers who have followed the progress of the work are well aware, all the excavation work on the canal through Culebra cut has up to this time been done in the dry by steam shovels. The cut has been drained by gravity to the east and to the west as the work proceeded; and at its eastern end a dike across the channel at Gamboa has prevented the flood waters of the Chagres River, and within recent months the rising waters in Gatun Lake, from flowing into the cut. As the level has been gradually lowered by excavation it has been necesasry to use pumps to lift the drainage water from the cut over the Gamboa dike.

On Oct. 1 the valves in the four 24-in. drainage pipes through the Gamboa dike, into which the pumps discharged, were opened and the waters of Gatun Lake were allowed to flow through the pipes into the cut for ten days. On Oct. 10 a charge of forty tons of dynamite, distributed in holes along the length of Gamboa dike, was set off, the initial electric impulse causing the explosion originating in an electric push button installed in the offices of President Wilson, at Washington, D. C. By special connections of land and submarine telegraph, this impulse was transmitted the entire distance from Washington to Panama, to set flowing the current which discharged the great blast.

While a certain amount of excavation remains to be done in the cut by dredging, it may fairly be considered that the present flooding of the cut, which for the first time establishes a navigable channel across the Continental divide, is the most conspicuous landmark in the completion of the work.

The only feature for regret in connection with this notable occasion is that the engineer who has been most closely identified with the Culebra work for the past half-dozen years, Col. D. Du B. Gaillard, who has been seriously ill for three months past, could not be present to witness this culminating event of the great task. Engineers who have visited the Panama work appreciate the extent to which Col. Gaillard's energy and ability have been devoted to the monumental work at Culebra; and the honor attaching to its successful prosecution is certainly his.

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## The Loss of the "Volturno," and Lifeboat Equipment of Ships

The worst marine disaster on record since the loss of the "Titanic" was the burning of the Uranium Line steamship "Volturno" at sea, on Oct. 9, with the loss of 150 or more of her passengers and crew, and the fortunate rescue of the remainder by ten transatlantic steamships, summoned to the aid of the doomed vessel by wireless telegraph.

The circumstances in connection with the "Volturno's" loss bring out prominently the fact to which frequent reference has been made in these columns, that the circumstances of the "Titanic" disaster have caused far too much emphasis to be laid upon the lifeboat equipment of ships. The chief loss of life on board the "Volturno" was among those who left the ship in lifeboats as soon as the fire became threatening, which boats were doubtless carried away and swamped in the high seas prevailing at the time. Those who remained on board until the storm abated were rescued by the surrounding steamers before the fire reached them.

It was indeed pointed out at the time of the "Titanic's" loss, that under the weather conditions which prevail a

large part of the time on the North Atlantic, the launching of a lifeboat and filling it with passengers from a large steamer is fraught with serious peril. It is impossible for such a boat to float long without swamping, and the process of taking such a boat and passengers on board a rescuing vessel is even more dangerous than the launching. These facts are all perfectly well known by those familiar with sea conditions; but to the general public the spectacle of the "Carmania," the first rescuing ship to reach the "Volturno," standing by for 24 hours unable to rescue one of the passengers on the burning steamer, only a few hundred feet away, is a vivid revelation of the limitations of lifeboat work on the North Atlantic.

As has been previously pointed out in these columns, in order to effect the greatest improvement in safety at sea emphasis ought to be laid on fireproof ship construction and methods of retarding the spread of flames, rather than overloading ships with lifeboats, which may even under some circumstances promote the spread of the flames over the upper decks.

The disastrous fire at the North German Lloyd piers and the steamships lying beside them, at Hoboken, N. J., in 1900, and the severe fire on board the "Imperator" while lying at her Hoboken pier this summer are illustrations of the extent to which the fire danger on board ships is very real and very serious. The burning of the "Volturno" may well turn the attention of the International Conference on safety of ships at sea toward better methods of ship construction to limit the spread of flames.

## De-Centralizing Great Organizations

We have noted in these columns from time to time the work which has been done in some of the larger railway, industrial and government organizations, toward de-centralizing the control and management. It is agreed by most of those who have closely followed the progress of consolidation in industrial organizations, that in many cases it has gone too far, and a serious loss in efficiency has resulted. There is no doubt that production on a large scale has great advantages in point of economy over small-scale production, but there are many instances where a great organization has outgrown the capacity of the men at the head to efficiently and economically supervise its operations.

The latest example of de-centralization is furnished by the New York, New Haven & Hartford Railroad Co., whose Board of Directors on Oct. 3 adopted resolutions, declaring their intention to radically revise their organization, providing a separate president and executive staff for the Boston & Maine system, for the New York, Ontario & Western R.R., and for the New Haven system. Similar action is announced as decided upon, as soon as practicable, with reference to the street-railway lines and steamship lines controlled by the New Haven company. While this action is taken under the spur of the recent condemnatory report of the Interstate Commerce Commission upon the New Haven system, there can be little doubt that the directors are convinced, by the logic of events, as well as by public criticism, that their policy of centralization has been carried too far.

One paragraph of the resolutions adopted by the Board is especially significant. We quote as follows:

> In addition to taking these steps, action has been taken about reducing the size of the operating divisions on the New Haven Road so as to make certain that superintende[nts] are not overburdened, and therefore unable to give thorou[gh] attention to safe and economical operation, and unable t[o] keep in touch with the employees and the public.

It is pretty well known that a large proporti[on] at least, of railway operating officers are overworked. [That] is to say, their routine duties take up so much o[f] their time that they have little strength or leisure left t[o] carry out two important lines of work which they shou[ld] not neglect; to wit, cultivating closer personal acquain[t]ance with the men of their operating force, and also wit[h] the men of influence and position in the communities w[hich] they serve.

One result of the current craze for efficiency, as re[pre]sented in low cost figures, has been the attempt to make an economical showing by cutting down the number of supervising officials as fast as consolidations were effected. In this way, it has not seldom happened that one man has been set to do the work which two men did before. The result in too many cases has been either a nervous breakdown or the shoving aside of such work as would suffer least by neglect. In many cases the neglect has cost the company, in the long run, many times the amount of the salary saved.

## Reforms Needed in Parcel-Post Administration

One of the well known defects in governmental execution of business affairs is that when a task is to be undertaken sufficient time for proper preparation is seldom allowed. For years Congress has had before it the question of establishing a parcel post, and there is no doubt that had businesslike methods prevailed in Government administration it would have been established long ago. When Congress finally acted, however, it ordered the Post Office Department to undertake the carriage of parcels on very short notice. Congress itself might dilly-dally over the matter for years; but when it had once acted it demanded results at once, without any comprehension of the fact that to build up an efficient organization to carry out a great task is a work which demands months and years. The public, therefore, should, and we believe does, make large allowances for the present glaring defects in the administration of the parcel-post service. Nevertheless, it is proper that some of the notable defects should be pointed out.

One of these is the remarkable jump in the rate between the second zone and the third zone. On all parcels above three pounds in weight the charge for the third zone is three or four times what it is for the second zone. For example, for a 10-lb. package sent a distance of 50 to 150 miles the rate by parcel post is only 14c.; but as soon as the 150-mile limit is passed the rate jumps to 52c. The increases for the zones beyond the third zone are moderate and reasonable.

It may be said, of course, that this discrepancy has arisen through the lowering of the rates in the second zone (50 to 150 miles) so that they are no greater than the rates in the first zone; but this explanation does not excuse the discrepancy. If the rates are to be based on the cost of carriage according to the distance, they should conform to that "rule of reason" which the Supreme Court has lately emphasized. The government is strenuously and properly demanding that all rates charged by the railways shall be reasonable. When it goes into the

transportation business itself, it is bound to do what it requires of others.

A still more serious defect in the parcel-post administration and one which is far harder to remedy is the rough handling which parcels receive. Apparently, the government officials have attempted to carry on the parcel post in the same manner that they carried merchandise before the parcel post was established; that is, by promiscuous dumping into heavy bags of all sorts of parcels indiscriminately. The natural result, of course, is that only heavy articles or those most substantially packed survive. Fragile parcels subjected to this sort of "rattler" test arrive at their destination, if they arrive at all, badly injured or ruined.

The public has been told repeatedly that the parcel post was to relieve the public from the extortions of the express companies, and many comparisons have been made between the parcel-post rates and express rates. Express companies, however, are responsible for the safe carriage of the goods which they handle; and they have learned by long years of experience how to handle even the most fragile packages so that they arrive safely at destination. If the express business were to be carried on for one day as the parcel post is now carried on, the claim departments would be swamped with business enough to last them a year.

It is evident that if the parcel post is to be carried on as at present, its use will soon be confined to that class of merchandise shipments which can stand rough handling without injury; and all other classes of goods will continue to be handled by the express companies. Such a program, however, will fall far short of meeting public expectations. If the government is to undertake the carriage of small parcels as part of the post-office business, it should do as other governments have done and establish a system by which such parcels can be transported with at least reasonable safety against damage.

## Starting the Work of Flood Protection

The problem of flood protection in the Central States, to prevent the recurrence of disasters like that of last March, comes into prominent view through four reports appearing almost simultaneously—that of the special board of Army Engineers, that of the Geological Survey, and the two reports of consulting engineers on protective works for the cities of Columbus and Dayton. (A report for the city of Lima, Ohio, has been received since this was put in type.)

The Army Engineers' report, a very interesting document, is rather obscure in one point, and may mislead those who have not followed the stream-control situation. Both from the Board's report and from the memorandum of the Chief of Engineers the reader might conclude that the War Department has in the past exercised control over navigable rivers in their entirety. That is by no means the case. In the first place, not all navigable rivers have been controlled (or supervised, or even studied) by the Army Engineers, but only those rivers *which have been declared navigable.* In the second place, even such rivers have not been controlled in their entirety, but the control has been carefully confined to the *navigable channel,* or better the low-water width; the public's interests in the valley outside of this width have not been recognized, except on the Mississippi and some of its tributaries.

For example, the present experience shows, by the testimony of the Army Engineer Board itself, that railway embankments across valleys outside the low-water width may be harmful to the general interest. When in the past a railway prepared to build a crossing over a navigable river, and submitted its plans to the War Department for approval, the department took jurisdiction of the channel bridge alone, and paid no attention to the embankments or trestles connecting the bridge with the valley sides.

This condition of affairs, which is not hinted at in the Board's report, is one of the two reasons why the flood plains of rivers have been a no-man's land. The other reason is to be found in the fact that State legislatures did not assert control over the flood plains when the representatives of Federal authority thus disclaimed Federal control. Congress also permitted the situation to remain chaotic.

The War Department doubtless had good grounds for being thus backward about taking authority over more than the strict field outlined by statute. And yet it is extremely unfortunate, we now can see, that the Department took this attitude. Other bureaus of the Federal government have been less scrupulous; on their own iniative they developed their sphere of action far beyond the limits of their instructions. So for example the Geological Survey, under the caption of water-supply studies, tackled some problems of river flow and flood prevention years ago; and, still extending its field in the same direction, it now issues a lengthy report on the floods of last March, also under the cloak of water-supply studies. Had the Army Engineers in past years displayed similar aggressiveness to push boldly out from the limits of their specific instructions into correlated fields of work, we might long ago have had the various existing defects of river-valley administration brought to public attention.

As matters stand now, the Army Engineers make a distinct claim—for the first time—that full-width control not only of navigable rivers, but also of their branches, is a necessary part of navigation control. They also imply that the future Federal flood-prevention work should be in the hands of the War Department exclusively. But on the other hand the Geological Survey also claims part of this work, if we read correctly between the lines. We hope it will not develop into a situation on which rival Federal bureaus will plan and construct different river works in a single stream valley.

That Federal flood-prevention should be mentioned primarily and nothing said of State or community work may appear strange; but there is no doubt that the inhabitants of the flood districts are looking toward the pouring out of national funds to protect them. There is a very neat passage in the Geological Survey report which indicates that Messrs. Horton and Jackson also thought mainly of work by the Federal Government:

> Thus, with the added possibility of floods of greater magnitude than have ever occurred in the past, it would seem wise and proper that a generous interpretation should be placed upon the amount of money to be expended for purposes of flood control in the Ohio Valley.

If the words "wise" and "generous" in this passage do not refer to the patriarchal mind and openhanded philanthropy of Uncle Sam, we miss our guess.

The great need of the case, that the river-valley com-

munities should band themselves together in associations for joint planning and building of protective works, under the ægis of State legislation, is in danger of being pushed to the background by this emphasis on Federal work. A valuable half-year, since the great floods, has been lost without much progress toward confederation of this kind. The first urgings in the proper direction appear in the consulting engineers' reports to Columbus and Dayton. It is to be hoped that they will bear fruit in the very near future.

These two reports—by Alvord & Burdick on Columbus, and by the Morgan Engineering Co. on Dayton—present a curious contrast in their recommendations. The former lays stress on river-channel enlargement, while the latter virtually discards channel work and makes strong advocacy of exclusive storage-reservoir construction. The physical conditions at the two cities are different, of course. At Dayton any diversion or river-correction work would have to be much more radical than at Columbus. Yet the river conditions at Dayton are fully as bad and require amelioration as urgently as anywhere along either the Scioto or Miami. Possibly the Dayton engineers realized, however, that plans requiring radical alteration in the city itself would have to meet the least bulk of inertia which a community can bring to bear, whereas most citizens would favor a scheme whose ideal is the complete subjugation of the river while placing the inconvenience on outside districts rather than city territory.

The largest river in Ohio, the Muskingum, is still to be heard from. If the Miami requires six reservoirs to control it, the four or five times greater Muskingum may need a dozen or twenty. In the carrying out of such extensive and important improvements the state itself ought to play an important part. The Ohio situation is difficult enough to call for the best and broadest planning.

# LETTERS TO THE EDITOR

## A Fraternal American Engineering Society

Sir—The statement in the editorial on p. 369 of ENGINEERING NEWS, Aug. 21, that Great Britain has in the Junior Institution of Engineers a society which has no counterpart in this country, should not be permitted to pass without correction. America has a national society which, as far as one may judge from the editorial referred to, is identical both in aims and methods with the Junior Institution. This is the American Society of Engineer Draftsmen.

In the matter of name and age only there appear to be essential differences between the two associations, for while the Junior Institution is stated to have been established "many years" [29 years], the American Society of Engineer Draftsmen is only a baby in the engineering world. It can justly claim, however, to be a very lusty infant.

The American Society of Engineer Draftsmen, although it has not existed long enough to have permitted its early members to reach top-notch positions, has, nevertheless, among its members men in top-notch positions, some of whom are members of the leading engineering societies of this country. These men joined the Society on account of their sympathy with the objects of the association and their belief in the necessity and usefulness of such an organization for the junior engineers of America. The President of the Society is Prof. Chas. Wm. Weick, M. Am. Soc. M. E., head of the Department of Mechanical Drawing in Teachers College, Columbia University.

Among the forces which compelled the formation of the Junior Institution of Engineers and the American Society of Engineering Draftsmen are: the fierce competition for employment among junior engineers; the poor remuneration (considering the time and money spent on education) resulting from this competition; the utter chaos which exists in the engineering world in the matter of placing a man in a position where his ability can be used to the greatest advantage, and the fact that the established engineering societies are formed "to advance engineering and science," and that they do not consider the individual further than to induce "social intercourse."

Your correspondent of Jan. 2, 1913, whom you quote, appears to have had some conception of these conditions and proceeded to put it up to his society to rectify them. The American Society of Civil Engineers is not rectifying them, however, for the reason that the time has not yet arrived when the forces which control that organization (rich and influential as it may be) work in that direction. The force which will compel this or any of the other large societies to act in that direction is the force of public opinion; and public opinion has not yet decided that the human side in engineering is paramount to the scientific; and until that time comes there is need as your correspondent says, for a new organization. That new organization, which is rapidly developing, is the American Society of Engineer Draftsmen.

Some idea of the great need of the new organization may be gained from the fact that if we combine the membership of the 200-odd societies given in the ENGINEERING NEWS directory of August, 1911, with the exception of the Stationary Engineers, we have not half the estimated number of men engaged in the profession of engineering.

For more than two out of the three years it has been in existence the American Society of Engineer Draftsmen has held regular monthly meetings at which have been read original papers by members and lectures given by speakers of the highest order, whose services have been placed at the disposal of the Society through the active influence of its President. An abstract of one of these lectures (by Dr. F. R. Hutton) may be found in ENGINEERING NEWS of Jan. 13, 1913.

By way of exemplifying the field there is for such an

organization, it may be stated that the Society holds the record for rapid increase of growth in attendance at meetings in the Engineering Societies' Building (New York City), where a careful check is kept on the attendances of all the engineering societies meeting there.

Considerable publication work has already been done, the first action in this direction being the publication of the papers read by members. This was immediately followed up by an Employment Bulletin and Data Cards. Then came a small sheet carrying Society news, and this has now been superseded by a regular monthly *Journal*, which contains a Society article outlining the progress being made; papers and lectures; a correspondence column which forms an open forum for discussions of interest to members; extracts from technical magazines which may be considered of special interest to the fraternity, lists of new members elected each month and committee and branch Society notices.

The primary importance of an active Employment Department was recognized from an early date and an immense amount of successful work has been done in this connection. The first step was to let employers know that a clearing house had been established and then the problem of bringing the vacancies to the attention of members was solved by issuing an Employment Bulletin.

This Bulletin shows, at a glance, the nature of the work to be done, whether the position is permanent or temporary, the range of salary offered, the working hours in the office, whether traveling expenses will be paid and the locality.

As an instance of the cordial relations which exist between employers and the Society it may be stated that many of the largest employers of draftsmen in New York City post from one to six notices of the regular monthly meetings in their drafting rooms. Several of the technical colleges also post notices of the meetings and the employment bulletins, which are of great interest to men who are nearly completing their courses and those who work during the day and take night courses.

From the early experiences of the Employment Department it became apparent that classification lists, both of members and employers, would have to be maintained. This work called forth another display of the loyalty and determination of the members, for an Employment Committee was formed and as a result of its untiring efforts, service record sheets have been obtained from all interested members, and from these sheets complete classification lists of members have been developed for each branch of engineering.

The result of this work is that if an employer writes in for a man experienced in a certain line of work, each member having that experience can be immediately located and the degree of experience he has had be determined at the same time, so that a $50 a week man would not be sent to seek a position offering $20 or *vice versa*. As an additional assistance out-of-work cards have been prepared so that such names may be kept in the foreground; and then to make records complete each man who is placed fills out another card giving all particulars of his contract. The classification lists of employers show the nature of the work they do, the number of men of each grade employed and other particulars of interest and importance.

The junior American engineer, therefore, does not stand in need of any commiseration when he has an institution right at hand laid on such a thorough foundation as to build an organization which need take second place to none having similar aims. From the rapid growth which has already been made it is sufficiently evident that the junior engineer knows that only an organization which is going to study his interests, or as your editorial says, discuss the problems affecting the human side of engineering, is going to be of real worth to him.

Your editorial states that "many of the younger members of the profession are becoming restless and dissatisfied with the attitude of those who control the work and activities of the engineering societies." If this is the case, it can only be attributed to the ignorance of the junior members of the declared aims of the engineering societies, which are, in general, to advance science and engineering.

Before the large societies can effectively face the problems affecting the human side of engineering, they will be obliged to modify their declarations of aims and purposes; and before they can hope to do that the shining lights of the profession will have to be shown wherein lies the brotherhood and community of interest between themselves and the little fellows.

Until this time comes to pass there is only one way to allay what you term the restlessness and dissatisfaction of the younger members of the profession and at the same time save them from what you designate "the secret agitation for labor union methods of improving the condition of young engineers." That way is the method adopted by the Junior Institution of Engineers and the American Society of Engineer Draftsmen.

WALTER M. SMYTH,
Sec'y American Society of Engineer Draftsmen.
74 Cortlandt St., New York City.

## The Crown Suitable for Bituminous Macadam Pavements

Sir—Referring to the excellent paper presented before the International Road Congress on "Causes of Wear and Deterioration of Roadways," by L. J. Hewes, reprinted in the Sept. 25 issue of ENGINEERING NEWS, I wish to call attention to the error that is frequently made in tar-macadam roads by adopting too high a crown. It is common to use the same crown that has been found best for water-bound macadam; and in changing from one pavement to the other it is convenient to retain the same crown because of the expense of changing manhole covers, curbs and other roadway structures.

Where the crown is high the slope near the gutters is so steep that the bituminous material draws into the gutters in warm weather. This not only makes trouble by its presence as a sticky mass, but it drains the necessary binder from the central portion of the roadway, rendering the surface liable to ravel when the temperature drops.

The object of a crown is to draw surface water to the gutters. The surface of a tar-macadam pavement is so smooth that very little inclination is needed for this purpose and probably 2 in. is enough for this kind of pavement where 6 in. would be needed for water-bound macadam. Steep side slopes of smooth pavement are objectionable also from causing automobiles to skid dangerously.

I think this feature of proper crown for roadways of different kinds of surfacing should be gone into much more fully than it has been in recent literature, so far as I have noticed.

J. P. SNOW.

18 Tremont St., Boston, Mass., Oct. 4, 1913.

## On the Value of Membership in the American Society of Civil Engineers

Sir—The letter of H. B. Kirkpatrick in your issue of Sept. 11, 1913, p. 524, brings up several points meriting discussion.

Primarily, what is the American Society of Civil Engineers? It is *not* a club. That is perhaps the first mistake Mr. Kirkpatrick made on his trip to New York. It should not be a club and probably never will be a club.

The Society is a body of over 7000 men scattered all over this globe—a ponderous body to be sure. It is inconceivable that the work incident to preparing the publications, sending out of notices, etc., for such a large body should be done gratis. Hence, somebody has to be hired and paid to do it. If they get their living that way, all well and good, so long as the work is well done.

If Mr. Kirkpatrick feels that his money is not well invested he might well resign; but it would be wiser first to try to change his attitude toward the world in general, for running all through his letter is an undertone of pessimism of the worst sort—the kind of pessimism which makes men sit back and grumble because the world doesn't bow at their feet and beg for a chance to serve *them*.

The world is too busy about its own business, my brother. If you want it to serve you, you must whip it into obedience. You will wake up some day and, like the rest of us, find you are whipping yourself; for every man is his own world, and he gets out of it only what he gives himself. Some of us can't give ourselves much; but we were born that way. A careful perusal and study of President Swain's address before the Society at the recent convention in Ottawa will do us all good.

The Society is not a man nor a thing with the power to please all its members. The Society is a body of 7000 men, each one having an active part to play. Offhand, I should say that $\frac{6999}{7000}$ of the Society have naturally more to do with shaping its policies than $\frac{1}{7000}$ of the Society. This means that things will go on as they have been in the past unless more than one member undertakes to make a change.

I am not at all of the opinion that the one member is entirely wrong in his views, but I am of the opinion that he cannot sit back and say, "let the Society wake up and do thus and so," when he is a part of that Society, unless he himself wakes up, and wakes up a sufficient number of members to put the change through.

I, too, wear a pin. I have worn it for ten years. But I never had an idea that the pin would get me a job. It probably is used often enough as a shield behind which certain members try to hide the inexperience or incompetency that shows only too plainly on their faces or in their past work. This in itself is a valid reason why the Society should not assume any responsibility for its members. If Mr. Kirkpatrick thinks it over I believe it will come to the same conclusion.

I am willing to concede that a great part of the [illegible] members are wiser men than I. Further, I give them credit for being interested in the welfare of the Society and I believe they are working for its good and for the good of the individual member.

The Society is naturally unwieldy and it will take time to make it perfect. At best the Society will not please all. We shall have to adjust ourselves to it. We need patience and perseverance. The formation of local associations of members is a step in the right direction, and the movement is gaining ground.

At one of these associations where I am privileged to meet my fellow engineers socially at the lunch table as in a club, I feel perfectly free to discuss such problems as the betterment of the parent society.

It is more loyal to discuss such matters there than in the columns of ENGINEERING NEWS, not all the readers of which are members of the American Society of Civil Engineers; and surely disloyalty will never help to bring about the desired end.

If there is no such local branch at Evanston, Ill., I would suggest to Mr. Kirkpatrick that he at once organize one. It will do him good to talk over "family" affairs where they should be talked over—in the "family."

Membership in the American Society of Civil Engineers is a privilege and an oportunity. Make of it what you will, each according to his ability.

"BROTHER."

## Seven Principles for Increasing the Efficiency of Municipal Officials

Sir—Working in conjunction with the National Municipal League on the problem of increasing the efficiency of municipal officials, a problem of obvious and deep importance to many engineers, the following Seven Principles have been formulated:

**(1) Elimination of all considerations in the selection of all administrative officers (or members of the "operating" departments), except fitness, as determined by individual aptitude, training and practical experience.**

**(2) Perfection of methods of determining fitness of administrative officials, especially those of the higher executive class.**

**(3) Elimination of the residence requirement for all nonpolitical officers.**

**(4) Assurance of proper authority to qualified public servants in the exercise of administrative duties.**

**(5) Assurance of permanency of tenure promotion, and adequate compensation for satisfactory service.**

**(6) Expansion of the facilities for securing scientific information on all phases of municipal activities (Municipal Reference Libraries).**

**(7) Establishment of more adequate means for the training of men for administrative service, especially in its higher grades.**

Those who are trying to improve municipal administration would be helped by expressions of opinion from engineers and others in the technical branches of municipal work as to the soundness of these principles. Suggestions regarding (2) and (7) would be particularly welcome.

H. S. GILBERTSON,

Executive Secy., National Short Ballot Organization.

383 Fourth Ave., New York City, Oct. 4, 1913.

# Preliminary Report on Dayton Flood Protection

Following the report by Alvord & Burdick on flood protection for Columbus, Ohio, summarized in ENGINEERING NEWS three weeks ago (Sept. 25, 1913, p. 631), a report on flood protection for Dayton, Ohio, has just been made by the Morgan Engineering Co., of Memphis, Tenn. This concern was engaged by the Dayton Citizens Relief Commission last April. The commission apparently went beyond the thought of Dayton alone, as it included in its instructions to the Morgan Engineering Co. (for surveys and plans on flood protection) the whole Miami River valley north of the south line of Montgomery County, including the cities of Miamisburg, Dayton, Troy and Piqua. The instructions covered not only flood protection of cities but also reclamation of agricultural lands in this district.

The present report of the Morgan Engineering Co. is only a preliminary memorandum. It states very summarily the views and findings which the engineers have reached up to now. The engineers state that they have given consideration to all methods which have been proposed or which could be devised. This included even several projects for diverting one or more of the rivers at Dayton (the Miami, Stillwater and Mad Rivers) around the city by channels through the upland; but the engineers condemn these as entirely impracticable.

The projects which are discussed favorably are of three kinds: diversion projects, channel enlargement projects and reservoir-storage projects. The third class includes only the pure storage plan, as projects in which storage is combined with diversion or channel-improvement are included in the first two classes. No estimates of cost for any of these projects are presented, but certain expressions of favor are made on general principles.

Slightly condensing the company's statement of the nature of the several projects, they are as follows:

**Diversion Projects**

(1) Two storage reservoirs on the Stillwater River with the diversion of Mad River through the city along or near the route of the old Miami and Erie Canal and the improvement of the present channel to carry only the Miami River.

(2) Two storage reservoirs on the Stillwater River with the diversion of the Miami River just north of the city southward to a point east of the gas works, and then the diversion of both the Mad and Miami Rivers south along the old Miami and Erie Canal crossing the present course of the Miami River above the Stewart St. bridge, and thence southwesterly two miles or more.

(3) Diversion of the Mad River into the Miami and Stillwater north of town and the diversion of all three streams from a point near the Steele Dam southwesterly along the Old Miami Boulevard into the river near the Dayton View bridge; thence following the present course of the river to the mouth of Wolf Creek and thence southwesterly to the southern limits of the city and beyond.

**Channel Enlargement Projects**

(4) Improvement of the river channels throughout the city; removing all of the concrete bridges and replacing them with steel truss bridges with not more than two piers in the channel.

(5) Improvement of the river channels leaving the concrete bridges in the channels, but deepening their foundations from 10 to 20 ft.

(6) Straightening the Miami River channel by rounding off some of the sharpest bends and at the same time increasing its size.

(7) Raising the levees. In the plans heretofore mentioned it is intended to keep the water line below the present top of the levees. Raising the levees, improving the channel and lifting the concrete bridges to higher elevation is feasible, but would have the disadvantage that street grades approaching the bridges would be steeper, that the higher stage of water during a flood would tend to be a menace to the city and that higher levees would be a detriment to adjoining property.

**Storage Project**

(8) Two reservoirs on the Stillwater River, two on the Miami River, one on Loramie Creek and one on Mad River. The extreme flood flow at Dayton would be reduced to not more than one-fifth and at Hamilton to about one-third of the greatest flow during the flood of March, 1913.

The engineers discuss the difficulty of planning channel-improvement schemes on account of our imperfect knowledge of the hydraulic principles of river flow, in the following paragraph:

The projects for the improvement of the present river channel are the most difficult to deal with because of the bridges; of the tendency of the water to pile up at the outside of the bends in passing around the bends; of the necessity for paving the sides and part of the bottom of the channel with concrete to prevent the erosion which would result from high velocities, and especially the great loss of velocity at the bends in the river. In so crooked a river as the Miami and with so high velocities as we would have, the loss of velocity due to bends in the channel is one of the controlling conditions. The engineering principles underlying this point have never been well worked out, and we must give them very careful investigation in plans for channel improvement.

We know, however, that with the river channel improved but not straightened the water during extreme floods would be 10 to 15 ft. higher at the Herman Ave. bridge than it would be if the river were straight. If the bridge openings were left in their present condition except for protection to the piers, the water level at the Herman Ave. bridge would be more than 10 ft. higher than if there were no bridges to obstruct its flow. These few figures are given only to indicate the difficulties of the problems encountered in planning the improvement of the river channels.

The present river channel, with the water flowing at the top of the levees, would carry less than half of the flood of last March.

The engineers fail to comment on diversion or channel-improvement schemes. On the other hand, they comment at considerable length on the storage-reservoir scheme, and this comment is favorable, almost glowing.

At the time we began our investigations we did not believe that complete flood protection could be secured by storage reservoirs, and our investigation of this means of river control was carried out chiefly because it has been our policy to examine carefully every possible method of improvement. We find upon examination that due to the alternate widening and narrowing of the valleys of the Miami, Mad and Stillwater Rivers they are peculiarly adapted to the construction of reservoirs. We have investigated all of the more practicable sites over the watershed and have determined upon six which fully meet the requirements.

We have not completed estimates for any other methods of improvement, but have progressed far enough to make reasonably certain that if all the interests which are affected bear their proportions of the cost, flood protection for the Miami Valley can be secured by a system of storage reservoirs more cheaply and more quickly than by any other method. We have outlined a system which will give complete relief from floods to the entire Miami Valley from near the headwaters of the Miami River to the Ohio River, to the Stillwater Valley from West Milton to its outlet and to the town of Osborn on the Mad River.

The biggest item of cost in the system of storage reservoirs would be the lands taken. As the reservoirs would be empty during the crop-growing season of each year and as the ponding of the water during floods would tend to prevent soil erosion and would cause fertile mud to be deposited, the productive value of the lands within the reservoir would probably be increased. However, as it may be necessary to purchase a large part of these lands in securing right-of-way, we have included in our estimate of cost about half the total value of the lands below the water line during the most extreme floods, such as occurred last March.

A system of reservoirs the sole object of which would be complete flood prevention in the Miami Valley* would cost about $12,000,000.

We believe that the flood protection afforded by this system would be sufficient for all purposes in the Miami

*The report does not specify the storage capacity, but a statement attached to it gives the aggregate capacity of the six reservoirs as 40 billion cu.ft.

Valley. Should it appear, however, that the city of Hamilton should require further protection, it can be secured by the addition of another reservoir on Twin Creek above Germantown.

To protect the entire valley by means of reservoirs would require about half as much time as to protect Dayton alone by local works. We estimate that two to three years would be necessary to complete the construction of a reservoir system after the legal proceedings make construction possible.

In designing these reservoirs it seems desirable not to adhere closely to engineering practice in the construction of dams. The interests involved are so great that it is desirable to plan dams of heavier and larger section than is usual.

In view of the great amount of work involved in making accurate comparisons it will be some months before a final report on all methods of protection can be submitted. Our investigations have gone far enough to indicate that the cost of protection to the city by local works will be not less than $7,000,000 nor more than $10,000,000.

## Collapse of an Old 5-Ft. Brick Sewer, St. Louis, Mo.*

A street cave-in, 50x110 ft., 45 ft. deep, and considerable other damage in Ferry St., between 14th St. and Blair Ave., St. Louis, Mo., was caused Sept. 20-22, by the collapse of an old 5-ft. circular brick sewer and the subsequent bursting of a 36-in. water main a short distance away from the broken sewer. The final collapse of

COLLAPSE OF AN OLD 5-FT. BRICK SEWER, FERRY ST., ST. LOUIS, MO.
(From a photograph taken before the bursting of the 36-in. water main.)

the pavement, revealing the great cavity in the street, fortunately occurred between the hours of midnight and 5 o'clock in the morning, so that there was no loss of life or injuries to passersby.

The sewer was built in 1878 of common brick laid in lime mortar, and at the point of collapse was 5-ft. inside diameter and 44 ft. below the street level. The disintegration of the mortar had evidently been going on for a long time, and it is supposed that early in the morning of Sept. 20 the arch of the sewer finally collapsed, causing a great quantity of the earth filling above to be carried away before the pavement over the cavity fell in.

Two days after the sewer collapse and while repair work was under way a 36-in. water main, a short distance west, burst, allowing the escape of about 4,000,000 gal. of water within a few hours. All this water soon found its way into the broken sewer above the point of failure, immediately flooding the cavity in Ferry St. This latter backed up in the sewers above, doing extensive damage. The pressure finally forced an opening through the debris into the sewer below the break, and the resulting flood increased the size of the cave-in to 50x110 ft.

In repairing the sewer the opening was too wide to allow cross-bracing, making it necessary to drive a row of piles on each side of the sewer to hold the sheathing in place. Meanwhile the damage done the sewer by the bursting of the water main and the subsequent flood it is feared may cause cave-ins at other points.

In commenting upon the cause of the failure, W. W. Horner, Principal Assistant Engineer, Sewer Department, writes:

It seems probable that the sewers affected were built in accordance with the best practice of the time at which they were constructed, and the present trouble here should be a warning to municipal engineers in general that the life of brick sewers built with lime mortar in the Seventies or earlier is about over. The closing of this particular break will be difficult and expensive, and further serious damage may result if heavy rains occur in the near future.

*From data furnished by W. W. Horner, Principal Assistant Engineer, Sewer Department, St. Louis, Mo.

## Annual Convention of the American Society of Municipal Improvements

The twentieth annual convention of the American Society of Municipal Improvements was held at Wilmington, Del., Oct. 7 to 10, with President B. E. Briggs, of Erie, Penn., in the chair. Upwards of 300 members and guests were registered but the attendance at any of the sessions rarely, if ever, reached a hundred and was commonly from 40 to 70. The program was notable for committee reports rather than for papers, of which last only a half-dozen were scheduled. Most of the committee reports were of the "progress" type but a number of these indicated actual progress rather than marking time. There was a small but interesting exhibit. Altogether the convention was a marked success, notably in the opportunity given for discussion and in the trolley, boat, and automobile rides tendered by the City of Wilmington.

### General Business

The Society accepted an offer from the Association for Standardizing Paving Specifications, under which the latter proposed to unite with the Society and turn over to it the funds in its treasury. This made necessary an amendment to the constitution which provides that cities may become members of the society and be represented by not more than six active members. Another constitutional amendment adopted authorizes the admission to active membership in the Society of engineers employed by counties and states.

The bylaws were amended so that hereafter there will be no committee on place of meeting but instead the choice of meeting will rest entirely with the convention. This change was made because both this year and last year the recommendations of the committee were disregarded by the convention.

As a result of the facts brought out by Mr. Folwell's

paper on municipal control of sidewalk construction and repair, the incoming president was authorized to appoint a committee on sidewalks.

Boston was chosen as the meeting place for 1914, by a vote of 30 against 12 for Dayton, Ohio, the place recommended by the committee.

In accordance with the ladder practice common in organizations like this one, Edward H. Christ, of Grand Rapids, Mich., was elected to the presidency. For secretary, C. C. Brown, of Indianapolis, who held that office a few years ago, was chosen in place of A. Prescott Folwell, who declined to serve longer.

Mr. Folwell's report for the past year showed the following membership at the opening of the convention: Active, 312; associate, 84; affiliated, 3; total, 399.

## Committee Reports

The committee reports of most note came from the committee on standard specifications and its 8 subcommittees and from the committee on standard forms and its 6 subcommittees.

Standard Specifications—C. C. Brown, of Indianapolis, chairman, made a short verbal report, which in a few instances was supplemented by reports of sub-committees. The only specifications recommended for adoption were those for stone-block pavements.

*Stone Block* (J. C. Hallock, chairman): Mr. Hallock recommended that the society adopt, with minor changes, the granite-block specifications adopted at Pittsburgh early in 1913 by the Association for Standardizing Paving Specifications; also that the same specifications, with slight changes in their first three paragraphs, be made standard for Medina block. This recommendation was adopted.*

*Brick* (E. H. Christ, chairman): Mr. Christ recommended no changes in the specifications previously submitted, but advised that the paper read before this convention by Prof. Edward Orton, of Columbus, Ohio, outlining the brick paving specifications of 1913 *proposed* by the American Society for Testing Materials be referred to the subcommittee, with authority to confer with the like committee of the society just named. These two recommendations were adopted, after some discussion which showed a strong difference of opinion as to the selection of brick for sampling. Mr. Christ and some other members of the American Society of Municipal Improvements, it appears, stand for more selective sampling than does the Testing Material Committee, which seems to incline more to random or mass sampling.

Speaking on the difference just mentioned, M. R. Sherrerd, of Newark, said that where ten brick are selected at random from a whole carload, instead of sets of samples of various classes of brick in the lot, manufacturers are tempted to put some No. 2 brick in each car in the hope of working them off.

There was also referred to the subcommittee on brick-paving specifications a paper by Wm. A. Howell, of Newark, N. J., on "The Standard Abrasion Test for Paving Brick—How It Works in Newark." Rattler tests for a number of years past were summarized with particular reference to uniformity of paving brick.

*Macadam and Gravel* (A. H. Blanchard, chairman): On recommendation, it was voted to change the name of this committee to "Broken Stone and Gravel." The committee is collecting data.

*Other Paving Specification Subcommittees*: The subcommittees on Asphalt (Geo. W. Craig), Concrete (F. R. Charles) and Wood Block (J. N. Hazlehurst) submitted no reports, although Mr. Hazlehurst sent in a letter expressing his personal opinion in favor of the old specifications for preservative oil. The subcommittee on Bituminous Specifications (Linn White) is collecting data.

*Sewer Specifications* (E. J. Fort, chairman): A report was submitted for discussion last year and printed in the 1912 *Proceedings*. Various suggestions for changes have been received, particularly as regards reinforced concrete, but final action has not yet been taken.

## Standard Forms

A committee on this subject was appointed in 1912, with A. P. Folwell as chairman. Mr. Folwell submitted a report for the main committee and for four of the subcommittees, but recommended none of the forms for final adoption except uniform bidding blanks for pavements and sewers, which were adopted by the society, as recommended by E. H. Christ. Mr. Folwell laid particular stress upon the importance of agreement upon, and use of, standard units in contract bidding and in reporting the amounts and cost of work done in each year, for the annual report. In paving, for instance, he urged that the bidding items be segregated so as to show the prices for (1) excavation, (2) concrete base, (3) curb, and (4) wearing surface. To illustrate the utter uselessness of many statistics collected and published without regard to these elements, he cited the belated census report on "General Statistics of Cities" (1909), in which the cost of brick pavements is reported in so many different ways of inclusiveness and exclusiveness of curbs, gutters, etc., as to make the figures of no use for comparative purposes.

The subcommittee forms reported for criticism, looking to further improvement, were a very compact one for Street Lighting (Geo. A. Sawin, Newark, N. J., chairman); and one for Street Cleaning and Refuse Disposal (J. T. Fetherston, Richmond Borough, New York City, chairman). The last named form is the one adopted by the American Public Health Association in 1911.*

Geo. C. Warren, of Boston, Mass., spoke heartily in favor of segregating bids into items. He also suggested the cutting out of all such phrases as "option of the engineer," saying that if the engineer could not tell in advance, for instance, where earth or other waste materials are to be deposited then the work should be paid for on the basis of the actual quantity and distance hauled.

Mr. Warren and some other members urged that concrete foundations should be paid for by the cubic yard, and not by the square yard, as proposed in the bidding forms finally adopted, since weak places may require extra thickness. Answer was made that in such cases the bids would (or could) still be on the basis of thickness, or such extra work could be paid for on the cubic yard basis. It was pointed out that where property owners

*For the benefit of some of our readers it may be stated that in 1911 and in 1912 the American Society of Municipal Improvements received various paving specifications from its committees, but hold them open for reision before final adoption. The Association for Standardizing Paving Specifications (now amalgamated with the society just named) has adopted a number of specifications. The committees of the two societies have collaborated to a considerable extent. Those interested in the specifications proposed and adopted may address C. C. Brown, Secy., American Society of Municipal Improvements, Indianapolis, Ind., for further information.

*See pp. 678-9 of our issue of Oct. 2, 1913, for some statistics reported in accordance with this form, which give a fair idea of the form itself.

pay for pavements, misunderstandings are avoided by reducing the prices to the square-yard basis.

In the light of Mr. Folwell's remarks on the lack of comparability of municipal statistics published by the Census, the delay in the latest bulletin, and further remarks as to the possibility that the collection of municipal statistics may be abandoned, the convention adopted a resolution urging that the collection of such statistics be continued, and that efforts be made to improve their character and to hasten their publication.

OTHER COMMITTEE REPORTS—Little or nothing was heard from the other committees. The one on Water-Works and Water-Supply (A. F. McCallum, Hamilton, Ont.) reported the defeat of a Minnesota bill to give the State Board of Health more power to protect water-supplies, urged the reduction of water-waste (citing Philadelphia as a "horrible example" of waste), and indorsed recent proposals to simplify sanitary water analyses.

### PAPERS AND DISCUSSIONS

SEWAGE TREATMENT AT SPRINGFIELD, MO.—One of two plants put in operation a few months ago was described by Alex. Potter, of New York City, who was engineer for both. The works described include grit chambers, "two-story" settling tanks (modified Imhoff tanks) sludge beds, sprinkling filters and a small final settling chamber.

The settling tanks are of reinforced concrete and resemble a four-leafed clover in plan. They differ from accepted design in containing a number of struts and in a provision for vertical circulation from the digesting chamber to the settling chamber above it, designed to carry upward not more than 2% of all the sewage treated.

Gas-engine driven traveling distributors, running back and forth on three tracks, distribute the sewage over the sprinkling filters. These distributors were made by the Ham Baker Co., of London, England. The beds are 53¾ ft. wide and 200 ft. long and the distributors travel lengthwise. They are fed from a trough, through a siphon which travels with the distributor. These distributors were chosen, Mr. Potter stated, because of their efficiency and because they would require only 1 ft. head, as compared with 5 ft. for spray nozzles. In winter it will be necessary to cut them out and operate the filters as contact beds. At the second and smaller plant nozzles are used to distribute the sewage.

Questions asked during the discussion of the paper showed some doubts as to the unusual features of the plant, particularly the struts, traveling distributor and the semicylindrical vents from the digesting chambers.

STATE CONTROL OF SEWAGE DISPOSAL—Under the title "What Obligations Should the State Be Under to Municipalities Ordered to Purify Their Sewage," Chester G. Wigley, engineer of the New Jersey State Board of Health, suggested that advice might properly be given as to the degree of purity and the best method of attaining it in any given case and as to the division of the cost among the communities benefited. As a matter of fact, the funds at the command of state boards of health do not enable them to go far into choice of methods, and they have no powers whatever as to apportionment of benefit among the cities benefited. It should be the duty of such boards, and they should be given the power, to see that sewage works are properly operated. Personally, Mr. Wigley believed that state aid in sewage disposal would be as proper as in road construction—an opinion indorsed by James Owen, of Newark, N. J., as worthy of consideration.

MINIMUM ILLUMINATION FOR STREET LIGHTING—Joseph E. Putnam, assistant city engineer, Rochester, N. Y., advocated amount or degree of illumination rather than candle power or amount of electrical energy as a basis for judging the efficiency of street lighting and showed by lantern slides a portable device for testing illumination used at Rochester, as well as concrete lighting poles and also lighting effects on various streets.

FIRE PREVENTION—Powell Evans, chairman of the Philadelphia Fire Prevention Commission, made a protest against fire waste, pleaded for physical standardization in the fire-prevention field, and urged systematic inspection to prevent fires, as has recently been practiced, by aid of firemen, in Philadelphia. State action against fire losses is needed. The interstate character of fire losses should be recognized, national studies of the subject made and the results published. Fire prevention standards should be established by the Federal Bureau of Standards.

A paper on "Education in Fire Prevention," by F. W. Fitzpatrick, Washington, D. C., was read by title.

ROLLING STREET EMBANKMENTS—A strong plea for consolidating road or street embankments by rolling instead of relying on natural settlement was made by Geo. C. Warren, of Boston. Mr. Warren cited some examples of bad settlement and damage to pavements where reliance had been placed on natural settlement and other examples with first-class results where rollers had been used. He had even gone to the trouble and expense of lowering a steam roller into a deep ravine and rolling the fill in 6-in. layers in order to prevent settlement.

OTHER PAPERS—A paper on "Separate and Combined Sewers in Their Relation to Sewage Disposal," by John H. Gregory, New York City, and one on "Control of Sidewalk Construction and Maintenance," by A. P. Folwell, New York City, have been reserved for separate treatment. Two other papers have already been mentioned as having been read and referred to the committee on brick-paving specifications.

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## The Control of Sidewalk Construction and Maintenance

The "Clearing House" of the American Society of Municipal Improvements undertakes to secure information on specific subjects for the members of the society. At the convention of the Society held at Wilmington, Del., Oct. 7 to 9 the results of an inquiry on the municipal control of sidewalk construction and maintenance were presented by A. Prescott Folwell, secretary of the Society. The paper summarized replies received from a number of engineers. The replies were classified under headings indicating the means and degree of control and the summary was followed by conclusions drawn by Mr. Folwell. We give here the names of the cities in each class and Mr. Folwell's conclusions. It should be understood that the entries in each class were necessarily somewhat arbitrary, owing to varying degrees of control. The classification is as shown on the next page.

WORK PERFORMED BY CITY—[Meaning either direct city labor or contract work at the instance of the city rather than the property owner.] Asheville, N. C.; Columbia, S. C.; Valdosta, Ga.; Richmond, Ind.; Aberdeen, Wash.; Hamilton, Ont.; Winnipeg, Man.; Lethbridge, Alberta; Victoria, B. C. (9 cities).

NO SUPERVISION—Pawtucket, R. I.;* Norristown, Penn.; Birmingham, Ala.; Fort Worth, Tex. (and probably other Texas cities); Quebec, P. Q. (9 cities.)

BONDING CONTRACTORS—Kalamazoo, Mich.; Decatur, Ill.; Ames, Ia.; Grank Forks, N. D.; Pine Bluff, Ark. (5 cities.)

INSPECTION—Binghamton, N. Y.; East Orange, N. J.; Wilkes-Barre, Penn.; Wilmington, N. C.; Charleston, S. C.; Lima, Ohio; Indianapolis, Ind.; Grand Rapids, Mich.; Holland, Mich.; Grand Rapids, Mich.; Atchison, Kan.; Manhattan, Kan.; Kansas City, Mo.; Fort Smith, Ark.; Austin, Tex.; San Angelo, Tex.; Santa Barbara, Calif. (16 cities.)

Many of the replies expressed opinions to the effect that further municipal control was necessary.

Mr. Folwell's comment on the replies is as follows:

In commenting upon these replies, the author would call especial attentfon to the arguments in favor of the method first described—that of treating sidewalk work in the same way as roadway work; and this method of treatment should, in his opinion, apply to the designing and general control as well as to the mere construction. By this he means that the material to be used and the time of construction should be determined by the department of highways or city engineer, and that the work should be put in an entire block at a time and not piecemeal.

It seems inevitable that most of the highway construction which is performed in small sections scattered over the town cannot receive as effective supervision by the city engineer as could a few contracts each covering an entire block or more. There certainly would seem to be little question that construction in 25- or 50-ft. sections must be quite a little more expensive and in many respects less satisfactory than if the entire block were constructed at one time. In addition to this, even where the work is well done, the patchy appearance of a street where old and new sidewalks alternate, and indeed where brick, flag and concrete may all be found on one block and in various stages of repair, is far from pleasing to the eye and is unpleasant for the pedestrian.

The sidewalk is as fully a part of the public highway as is the roadway, so far as its use is concerned. It is as free to the general public and is (or should be) no more used for private purposes by the abutting owner, and we can therefore see no reason why the two should receive different treatment.

As a matter of fact, in too many cases little attention is paid to the sidewalk. Volumes are written about roadway pavements, but only an occasional page about sidewalk paving; but yet to one person who uses the roadway there are probably ten who use the sidewalk. The additional property rights or quasi-ownership which in some cities are held by the abutting owner over the sidewalk need not interfere with the municipal control any more than they interfere with roadway paving in those states or cities where such ownership is construed as extending to the center of the highway.

And the logic of the argument would include also maintenance, including street cleaning. In German cities the street-cleaning gang cleans sidewalks as well as the roadway, in many cities flushing them down with hose during the night at the same time that the roadway is similarly treated. In large cities a considerable proportion of the dirt on the sidewalks is blown there from the roadway, and the remainder is carried or thrown there by the public at large, which uses the sidewalk (except for store sweepings or other dirt thrown from the abutting premises in violation of the city ordinances). It would therefore seem to be as much the city's business to remove this dirt from the sidewalks as to clean the roadways. An additional argument in favor of this is the fact that the dirt from the sidewalk is very apt to be blown or swept on to the roadway shortly after the latter has been cleaned, thus to some extent undoing the work of the street-cleaning gang; which would not have occurred had the entire street from property line to property line been cleaned at one operation.

Considering, however, merely the point of view of the cost of sidewalk construction, there would seem to be little reason to dispute the following statements: First, an improperly constructed sidewalk will be more expensive in the long run in that it must be renewed more frequently than one properly constructed. Second, inspection adequate to securing proper construction is very expensive when the work is done in small jobs of 25 or 50 ft. Third, construction in such small jobs is more expensive to the contractor and consequently to the property owner or city. Fourth, not only would it appear reasonable, but it has been demonstrated by experience, that the lowest prices can be obtained for sidewalk work by letting the contract for the work of an entire season to one or two contractors, with the understanding that no stretch of work of less than a block will be ordered.

*Geo. C. Carpenter, city engineer, stated that since he made the report to Mr. Folwell the city had assumed some measure of control.

## NOTES

**A Cave-in** in a trench at Main and Fair streets, Paterson, N. J., on Oct. 7, caught and smothered three Italian laborers who were working on a new underground conduit for the New York Telephone Co.

**A Locomotive Driving Wheel Came Off** through the breaking of an axle on a passenger train on the Central Vermont Ry., near Waterbury, Vt., on Oct. 6. The driving rods broke and their revolving ends did considerable damage to the locomotive. The engineer applied the brakes and jumped off and the train was safely brought to a stop.

**Heavy Floods in Southern Texas,** the result of the heavy rains of the two weeks prior to Oct. 3, caused the death of a number of persons and the destruction of much property. Houston during the past 15 days has had a rainfall of 20 in. In San Antonio the water in the streets reached a depth of 4 to 6 ft., on Oct. 2, and the public service utilities suspended operations. Many bridges were washed away.

**The Chicago Garbage-Disposal Situation** remains unchanged. At a meeting of the city council, the Chicago Reduction Co. submitted an offer to sell its plant for $383,000, instead of the $492,500 originally demanded, but the offer was rejected. The dumping of garbage in clay holes has been commenced, but vigorous protests have been made by persons in the neighborhood of the dumping spots, mainly on the score of nuisance and bad odors. The treatment with a deodorant solution is expected to reduce the nuisance to a minimum.

**A Temporary Railway Station** at St. Paul, Minn., has been erected by the St. Paul Union Depot Co., on the site of the station recently destroyed by fire, and ticket office was in service on Oct. 10. The baggage and mail departments were not damaged. By Oct. 12, all the station departments were ready for service in the temporary quarters. The rearrangement of the passenger terminals and the construction of a new station have been under consideration for some years by the numerous railways interested, and the destruction of the old station may help to the acceptance of some plan for the new work.

**The Trestle Approach of a Bridge Collapsed** under an electric car at Green Bay, Wis., on Oct. 14. No lives were lost. The bridge over the Fox River on the line of Main St., the most heavily traveled bridge in the city, consists of a steel through-truss swing-span and a long pile-trestle approach on the west. Both trestle and steel span are old, and have long been known to be in poor shape, but nothing has been done to provide a stronger and more modern structure. Both the street cars of the city lines and an interurban line operating large and heavy cars cross the bridge. About noon, Oct. 14, a sprinkling car of the electric railway broke through the timber approach, carrying down a section about 80 ft. long. The men on the car went down with it, but were rescued. The work which collapsed was rebuilt 16 years ago.

**A High Percentage of Profit** on a New York State road contract—Because the State Highway Department has cancelled the contract for the Bayshore-Brookhaven State road, the contractor, Charles V. Platt, of Port Jefferson, has filed a claim against the State of New York for $132,000, which he figures would have been the profit to him resulting from the contract had it been carried out.

The contract for this road was awarded to Mr. Platt last December and the work was commenced. The contract called for thirteen miles of State road to be built at a cost of about $246,000.—"Brooklyn Eagle," Oct. 9.

**A Head Collision** between a train bound for Middletown, N. Y., on the Berlin branch of the New York, New Haven & Hartford R.R. and a Meriden-bound electric car of the Meriden & Middletown Ry. (owned by the New York, New Haven & Hartford R.R.), at Westfield, Conn., on Oct. 10, resulted in the death of one passenger and the injury of 11 others. There is a single track from Westfield to Middletown, Conn., which branches at the former town, one line going to Berlin and the other to Meriden, Conn. The collision occurred on this stretch of track used by both steam and the electric trains. The

train is said to have been backing (according to custom) toward Middletown at 20 mi. per hour when it struck the electric car which was running toward it at 25 mi. per hour.

**A Butting Collision** occurred between a passenger train and a freight engine in the yards of the Chicago, Milwaukee & St. Paul R.R., at Madison, Wis., on Oct. 6, seriously injuring 12 persons. According to press dispatches, the railroad officials blame the switching crew for the accident. The latter are stated to have said that they thought the passenger train had arrived before they ran out on the main track where the collision occurred. The passenger train was 10 min. late and was moving at about 40 miles per hour when the switch engine was sighted a short distance ahead. The baggage and smoking cars of the passenger train were partly telescoped.

**Resolutions Adopted by the American Road Congress** at the Detroit meeting were in substance as follows: (1) Favoring the creation of a national department of public works with a cabinet officer at its head; (2) favoring the establishment of state highway commissions and state aid for highway construction; (3) favoring the establishment of a national road system for the construction of lateral and connecting market highways by states, counties and towns; (4) favoring the appointment by the President of the United States of a commission to investigate, report on and recommend a system of Federal aid for road construction ;(5) favoring legislation to enable the nation to be officially represented at the International Road Congress; (6) favoring the investigation of applications for patents relating to road and bridge construction by the Federal Office of Public Roads before patents are issued; (7) commending the Lincoln Highway Association and the National Old Trails Association; (8) endorsing the compulsory use of wide tires and the road drag; (9) favoring the use of convicts on road construction and maintenance; (10) favoring long tenure in office of experienced and efficient highway officials.

**The Milwaukee Sewerage and Sewage Disposal Plan Project,** after much delay of various kinds, has at last progressed as far as the appointment of four of the five commissioners under whose direction the improved means of sewage collection and disposal are to be planned and executed. The commissioners thus far appointed are: Michael Carpenter, Theo. A. Vilter, Conrad Niederman and Geo. P. Miller. The commissioners are to receive no salaries, but must give bonds for the faithful performance of their work. They are to continue in office until the work of the commission is completed, subject only to removal for unfaithfulness or political activity. The commission is authorized to employ a chief engineer and such other technical and professional advisors and assistants, and such clerks, laborers, etc., as it sees fit, and may fix their salaries and wages and discharge them at will, except as limited by contracts with highly trained, experienced or skilled individuals. It is to be noted, however, that the state civil service laws affecting the city are to govern the commission, except as regards appointees under contract and the chief engineer and secretary to the commission.

**A Large Pier and Industrial Development** is proposed by the New Jersey Harbor Commission for the west shore of upper New York harbor, between Constable Point and the Greenville freight terminal of the Pennsylvania R.R. As reported upon by the Commission's engineer, B. F. Cresson, Jr., the plan calls for building out two necks of land between Greenville and Constable Point, each 1500 ft. wide and 5000 ft. long, the out shore end being at the bulkhead line. Between these peninsulas would be a basin 1000 ft. wide. It is contemplated that the government pierhead line would be drawn in until it should be parallel and 1600 ft. off shore of the present bulkhead line. It would be expected that the federal government, in view of the importance of such a terminal and the proposed location of the new navy yard and naval station nearby would dredge a channel 1200 ft. wide and 35 ft. deep along this projected pierhead line. At the end of each one of these long fills would be three piers 1600 ft. long, 200 ft. wide, with a basin 350 ft. wide between. In the middle of the fill would be a number of oblique piers 700 ft. long, 125 ft. wide and 275 ft. apart. The shore line at Constable Point also would have several long piers. In this way, provision would be made for wharfage of all classes of ships, for lighters and floats, etc. Facilities are contemplated for the direct loading of grain into holds of ships, and for the supply of ships with bunker coal. Space is provided for classification yards and railroad freight buildings, with tracks along the bulkheads and in the piers.

**The S.S. "Volturno" Burned at Sea,** in about 48.25 N. latitude, 34.33 W. longitude, from causes not definitely known, while on her voyage from Rotterdam to New York. According to one story the fire was started by a heavy explosion in the bow, but this has not yet been verified. Press dispatches state that of the 24 cabin and 540 steerage passengers and a crew of 93 (making a total of 657 persons on the ship), 136 were lost, and 521 were rescued by the 10 steamships which responded to the wireless distress signals from the burning ship. The first wireless calls for assistance from the "Volturno" were received at about 8:10 a.m., on Oct. 10, and at 11:45 a.m. the first of the rescue ships arrived upon the scene. The removal of the passengers and crew was impossible until the tank-steamer "Narragansett" arrived at 7:10 a.m., Oct. 11, and reduced the roughness of the sea in the vicinity, by pouring upon it two large streams of oil. All of the passengers had been removed by a few minutes after 8 a.m., Oct. 11. About 24 hours elapsed between the time the first call for help was received and the transfer of the passengers. It is claimed that during this period the fire did not burn aft of the bridge. Apparently most of the deaths resulted from attempts to launch lifeboats from the side of the "Vulturno" into the heavy sea. Of six lifeboats lowered, only two (both of which disappeared) succeeded in clearing the side of the vessel; the other four, crowded with passengers and crew, were smashed against the hull and their occupants lost. The "Volturno" was owned by the Canadian Northern Steamship Co., but had been chartered to the Uranium line, the ships of which dock at Brooklyn, N. Y. She was built in England by the Fairfield Shipbuilding Co., in 1906.

**An Improved Locomotive Terminal** has been built for the Baltimore & Ohio R.R., at Cumberland, Md., by Westinghouse, Church, Kerr & Co., 37 Wall St., New York City. This place is situated at the foot of the eastern slope of the Allegheny Mountains and through here both passenger and freight traffic is heavy. Practically all the freight locomotives are of heavy mallet or of mikado type and the heaviest Pacific type is used for passenger service. The improved plant comprises a roundhouse with a 100-ft. motor-operated turntable, a double-cinder pit, a reinforced-concrete coaling station, a sand house and a small power house. To accommodate the large mallet locomotives, the roundhouse was made 110 ft. long and has 31 stalls with space for further extension. The building has brick walls on concrete foundations with timber roof posts and a wooden roof. The back wall is made up of brick pilasters with broad window spaces between, fitted with top and bottom sash counterbalanced with each other. The roof line is broken at the first row of posts near the front of the building so as to give a row of sash with narrow vertical louvres over each stall to provide light and ventilation. The engine pits are 88 ft. long with side walls for 40 ft. on the inner end wide enough for jack bearings. The pit walls extend 12 ft. outside the house to prevent track settlement. Twin driving-wheel drop pits, serving four stalls were provided and two stalls have truck wheel drop pits. These are furnished with hydraulic pneumatic jacks respectively, of 30 and 15 tons capacity. Each stall has a smokejack made of asbestos lumber supported on a wooden frame with a hood 4 ft. wide and 12 ft. long. The floor surface is half of creosoted wooden blocks and half of mastic rock, both on 6-in. concrete foundation. The building has an indirect heating system with fan capacity sufficient to change the air completely once in 15 minutes. Closely adjacent to the engine house and connected to it by a covered passageway, with a track leading to one of the stalls of the roundhouse, is a machine shop 70x140 ft. Here is equipment for light repairs. At the west end of the building is a toilet room and at the east end is a two-story office structure, 33x64 ft., providing rooms for the master mechanic, road foremen of engines, roundhouse foreman, storekeeper and clerks, and the engine dispatchers. The power house located nearby is 67x65 ft., having separate boiler and engine rooms. In the engine room is a 1000-ft. air compressor, three 50-kw. power transformers for power, a 50-kw. and a 25-kw. transformer for lighting, the latter for series arcs, and a fire pump. In the basement are the boiler-washing pumps. In the boiler room are two batteries of water-tube boilers, aggregating 1000 hp. rated capacity, with automatic stokers.

There is a cinder pit between the coaling station and the engine house. This is a double submerged type with an overhead traveling crane and grab bucket. About 120 engines are handled over the pit daily and one man working during daylight hours is able to remove all the cinders deposited. The coaling station has bunker capacity for 600 tons. There are four bins to handle three sizes of coal (run-of-mine, crushed-stoker and special-passenger). About 20 cu.yd. of dry sand can be stored overhead, and a nearby sand house has storage for 1200 cu.yd. of green sand which is dried by steam and elevated to the overhead storage bin by compressed air. All buildings are circled by a 6-in. fire line supplying

fourteen 4-in. two-way fire hydrants connected to the fire pumps in the power house. Three standpipes supply water to engines passing to and from the roundhouse.

**The Most Severe of Three Record Concentrated Rainfalls** in New York City during the present season occurred Oct. 1. As in the two previous deluges of July 28 and Sept. 5 respectively ("Engineering News," Aug. 7 and Sept. 11) the subway system of the Interborough Rapid Transit Co. was blocked. The interruption to passenger traffic, however, was more serious in this last rain, as other transportation lines besides the subways were put out of commission. At 3:45 p.m., the subway service between 72d St. and the Grand Central station at 42d St. was discontinued. Water poured into the subway so that it soon became necessary to stop traffic as far north as 96th St. Water entered the subway at 23rd, 46th, 81st, 116th and 157th streets on the Broadway line, and at 110th St. on the Lenox Ave. line.

As in the two preceding rains, the greatest trouble occurred at Times Square. The sewers again backed up through the basement of the Longacre building, and from there to the subway platform and onto the tracks, contributing to the flood which poured down the steps of the kiosks and through the sidewalk gratings, due to the inadequacy of the catch basins in the street and of the sewers themselves, which at this point were not designed to cope with such excessive floods.

In the subway, at Times Square, four pumps, which have a combined capacity of 2000 gal. per min. operated continuously, and in addition to these a car-pump which discharged 2000 gal. per min. operated for 40 min.; but obviously the pumping system was of little avail until the pressure in the sewers relaxed, as the water was pumped into the flooded streets, only to flow back again into the subway. At 5:30 p.m., when the rain began to abate, the water at Times Square station was two feet deep over all four tracks, and at its maximum reached twice that depth. At 7:20 p.m., the first southbound train reached Grand Central station, having passed through the flooded district, and service was restored.

Shoring in the excavation of the new subway under Church St. in the vicinity of Cortland St. was washed away, resulting in the weakening of the Sixth Ave. elevated railway structure on Church St., so that trains on this line had to be discontinued below Cortland St. from 2:50 to 4:30 p.m.

In Brooklyn, the Long Island R.R. service into the Flatbush Ave. station was abandoned from 3 to 6:30 p.m., and was not fully resumed until 9:30 p.m., due to the flood at the freight depot, situated at that station. Over part of the Brighton Beach line of the Brooklyn Rapid Transit Co., service was interrupted from 3 p.m. until after midnight. The part of this line which was in trouble passes through an open cut which was flooded. A sewer burst at Fourth Ave. and 44th St., Brooklyn, by the side of the excavation for the new subway, and dropped the street surface on which men of the Sewer Department were working, into the subway, a distance of 30 ft.

The following tabulation is a comparison of the rainfall over equal periods during the three recent rains:

INCHES OF RAINFALL

| Time minutes | Oct. 1 Battery | Oct. 1 Central Park | Central Park Sept. 5 | Central Park July 28 |
|---|---|---|---|---|
| 5 | 0.44 | 0.56 | 0.60 | 0.51 |
| 10 | 0.77 | 0.78 | 1.15 | 0.96 |
| 15 | 1.05 | 1.01 | 1.59 | 1.20 |
| 30 | 1.64 | 1.55 | 2.62 | 1.48 |
| 60 | 2.26 | 2.03 | 3.31 | 2.73 |
| 120 | 3.34 | 3.35 | 3.70 | 3.11 |
| 24 hr. | 5.16 | 5.07 | 4.14 | 3.11 |

**Final Stages of Construction on the Panama Canal**—Three events of great significance in connection with the Panama Canal have occurred within the last few weeks—the successful operation on Sept. 26 of the entire flight of locks at Gatun to pass the seagoing tug "Gatun" from the Atlantic channel to Gatun Lake; the flooding of the famous Culebra cut on Oct. 1, by opening the valves of the pipes through the Gamboa dike, which has shut out the waters of Gatun Lake during the period of steamshovel work, and the final destruction of the dike by a huge blast on Oct. 10.

The first use of the locks was made on Friday, Sept. 26, in order that two of the Army Engineers, Maj. James P. Jervey and Maj. George M. Hoffman, who have had immediate charge of the work at Gatun, under Lieut.-Col. W. L. Sibert, Division Engineer, might witness the actual completion of their labors before departing from the Isthmus to their new assignments.

The filling of the lock chambers occupied a longer time than normally, because of the small displacement of the tug; in the case of a large vessel, much less water would have been used. The total lift was approximately 64.70 ft., divided between the three locks, about as follows: Lower lock, 21.2 ft.; middle lock, 23.7 ft.; upper lock, 29.8 ft.

During this operation of the locks, all of the operating devices were operated from local control, that is, each machine was operated from the panel in the same room with the machine. This made it necessary for the operator to move from machine to machine for the various operations, whereas, when the plant is completed, the entire flight will be controlled from the central control tower.

The lockage of the vessel was under the immediate supervision of Col. H. F. Hodges, the designer of the locks, their equipment and operating machinery, and the regulating works of the canal. In this he was aided by Edward Schildhauer, the Electrical and Mechanical Engineer of the Commission, and the inventor of the mechanism which opens and closes the lock gates, and E. E. Lee, Superintendent of Erection; F. C. Clark, Assistant Superintendent of Erection; C. P. Fortney, Superintendent of Mechanical Installation; S. H. Grauten, Testing Engineer, and Geo. F. Guynn, Inspector of lock gates and protective devices. The vessel had among its passengers on this initial trip, Col. H. F. Hodges, Lieut.-Col. William L. Sibert and family, Maj. James P. Jervey, and Mrs. Jervey, Maj. George M. Hoffman, Lieut. Geo. R. Goethals and Mrs. Goethals, Henry Goldmark, Captain Corning, of the steamer "Panama," Mrs. Edward Schildhauer and Mrs. E. E. Lee.

Water was admitted into Culebra cut through the four 24-in. pipes extending into the lake underneath Gamboa dike, on Oct. 1. The slide at Cucaracha has completely closed the cut, in one place to the 73-ft. level, therefore, the water discharged into the canal by means of the pipes between Oct. 1 and 10 was wholly confined to the section between the slide and the dike. To overtop the slide, it will be necessary for the water in the lake to reach a level of 73 ft. above mean sea level. A ditch will be cut through Cucaracha slide to start the water through and, it is expected that a great deal of the slide material will be washed into the drainage ditch between the slide and Pedro Miguel locks.

The drainage pumps in the cut near the dike were shut down on Sept. 24; all the machinery was removed and the building which housed it was razed. Sufficient water had collected in the cut on Oct. 1, from seepage and surface drainage to cover the bottom between Cucaracha slide and the dike.

On Oct. 10 careful preparations had been made by the Western Union Telegraph Co. and the Central & South American Telegraph Co. for the continuous transmission from Washington of President Wilson's signal, which was to cause the first blast for the destruction of the Gamboa dike. Some 1220 charges of dynamite aggregating 40 tons were exploded in all. In the first blast were 400 of these charges, weighing a total of 1600 lb., the explosion of which removed the top of the dam; the other charges were exploded later at intervals. It now remains for dredges to complete the cut.

## PERSONALS

Mr. J. R. Mann has been appointed Superintendent of Transportation of the Detroit & Toledo Short Line R.R., with headquarters at Detroit, Mich.

Mr. H. H. Berry, recently Superintendent of the Western Maryland Ry., at Hagerstown, Md., has been appointed Superintendent of the Denver & Rio Grande R.R., at Pueblo, Colo.

Mr. James D. Tyter, Superintendent of the Fitchburg division of the Boston & Maine R.R., at Boston, Mass., has been promoted to be General Superintendent, succeeding the late W. F. Ray.

Mr. C. A. McCarthy, former Master Mechanic of the Chicago, Rock Island & Pacific Ry., at Shawnee, Okla., is now Master Mechanic of the Colorado Springs & Cripple Creek District Ry., at Colorado Springs, Colo.

Mr. C. C. Whittier, recently in charge of the Winnipeg, Man., branch of Robert W. Hunt & Co., Ltd., has been made Treasurer and General Manager, with headquarters at 905 McGill Bldg., Montreal, Que.

Mr. Joseph Harrington, Chief Consulting Engineer for the Green Engineering Co., Chicago, Ill., has resigned to engage in private practice with offices in Chicago. He will specialize in boiler-plant design, equipment and operation.

Mr. G. H. Folger, recently Assistant General Superintendent of the Boston & Maine R.R., at Boston, Mass., has been appointed Superintendent of the Terminal division, with headquarters at Boston, and his former position has been abolished.

Mr. W. J. Frauendiener, recently General Inspector of the locomotive department of the Cleveland, Chicago & St. Louis R.R., at Indianapolis, Ind., has been appointed Master Mechanic of the Eastern division at Bellefontaine, Ohio, succeeding Mr. J. T. Luscombe, resigned.

Mr. David B. Fleming, formerly Assistant Superintendent of the Mohawk division of the New York Central & Hudson River R.R., is now Superintendent of the Buffalo division at Buffalo, N. Y. He was born in 1877 and entered the service of the New York Central Lines in 1893 as a telegraph operator.

Mr. D. F. Schaff, Superintendent of the Chicago division of the Cleveland, Cincinnati, Chicago & St. Louis R.R., at Indianapolis, Ind., has been granted a six-months leave of absence. Mr. C. S. Millard, Superintendent of the Michigan division, will assume charge of the Chicago division temporarily.

Mr. R. N. Dickman, M. Am. Inst. M. E., Mining Engineer of Chicago, Ill., has become associated with Robert W. Hunt & Co. His headquarters will be at 2200 Insurance Exchange, Chicago. Mr. Dickman is now engaged in the examination of gypsum and coal properties in Western Canada, for the Robert W. Hunt & Co., Ltd., of Canada.

Mr. E. J. Devans, Division Superintendent of the Buffalo, Rochester & Pittsburgh R.R., at Rochester, N. Y., has been promoted to be General Superintenent in charge of transportation, with headquarters at Rochester. He is succeeded as Division Superintendent by Mr. M. G. McInerney, former Assistant Superintendent at Rochester.

Mr. F. B. Walker, Assoc. M. Am. Soc. C. E., formerly Chief Engineer of the Arizona Land & Irrigation Co., Prescott, Ariz., has been appointed Assistant Engineer of the Chicago, Milwaukee & St. Paul Ry., at Lewiston, Mont., succeeding Mr. F. J. Herlihy, whose resignation to accept a position with the Cook Construction Co., of Montreal, Que., was noted in our issue of last week.

Mr. Fred O. Dolson, recently Hydraulic and Irrigation Engineer of the Pacific Power & Light Co., Portland, Ore., for four years previously Erecting Engineer for the Pelton Water Wheel Co., has left the West coast for New York City, via the Panama Canal. He is soon to leave New York on an extended trip through South America for the purpose of introducing American machinery.

Mr. Arthur Sessions, Superintendent of Transportation of the Central division of the Panama Canal, has resigned to become General Superintendent of Transportation of the Bocas division of the United Fruit Co., with headquarters at Bocas del Toro, Panama. Mr. Sessions went to the Isthmus in 1905 as Trainmaster. He was promoted to be Assistant Superintendent of Transportation in 1906 and Superintendent in 1908.

Mr. William J. Cunningham, Assistant Professor of transportation at Harvard University, has been appointed Assistant to Vice-President (to be President as soon as the change in the railway company's by-laws is effected), J. H. Hustis, of the New York, New Haven & Hartford R.R., with offices in New Haven, Conn. Prof. Cunningham has been granted two years' leave of absence from the University, but will continue to lecture there on transportation subjects.

Mr. Searcy B. Slack, recently City Engineer of La Grange and County Surveyor of Troup County, Ga., has been appointed Adjunct Professor of civil engineering at the University of Georgia, succeeding Prof. John C. Koch, Assoc. M. Am. Soc. C. E., who is taking up special work at Johns Hopkins University, Baltimore, Md. Prof. Slack is a civil engineering graduate of the University of Georgia, class of 1911, and a Master of Arts of Harvard University, class of 1912.

Mr. W. J. Knight, Assoc. M. Am. Soc. C. E., recently Chief Engineer of the Gilsonite Construction Co., St. Louis, Mo., is now associated with Mr. G. S. Bergendahl, Assoc. M. Am. Soc. C. E., President of the Bergendahl-Bass Engineering & Construction Co., 1311 Harriss Trust Bldg., Chicago, Ill., under the firm name of Bergendahl-Knight Co., with offices at the above address in Chicago. The firm will make a specialty of reinforced-concrete and structural steel design and construction.

Mr. Henry Welles Durham, M. Am. Soc. C. E., Chief Engineer of Highways, Borough of Manhattan, New York City, has recently completed an extensive tour of investigation of paving and street maintenance work in European cities in the interests of the City of New York. Mr. Durham was appointed by the late Mayor Gaynor a delegate to the recent International Road Congress, at London, England, and by direction of the Mayor devoted the remainder of the summer to a detailed study of European pavements.

Messrs. Herbert H. Conway, a graduate in civil e[illegible]ering of Cornell University, and recently in charge of [illegible]ment-testing laboratory of the Northern Pacific Ry., [illegible]coma, Wash., and E. T. Asplundh, a graduate in civ[illegible]neering of Pennsylvania State College and recently w[illegible] Turner Concrete Steel Co., Philadelphia, Penn., have [illegible] a partnership under the firm name of Conway & As[illegible] Engineers, with offices at 418 Tacoma Bldg., Tacoma, [illegible] They will make a specialty of reinforced-concrete b[illegible] construction and design.

Mr. Albert J. Himes, M. Am. Soc. C. E., Engineer of [illegible] Elimination, Cleveland, Ohio, New York, Chicago & St. [illegible] R.R., and former Resident Engineer of the Eastern d[illegible] of the New York State Canals, has been appointed Va[illegible] Engineer of the railway company. He will be assiste[illegible] committee, of which he is the chairman, consisting of M[illegible] E. A. Miller, Superintendent of Motive Power and Equip[illegible], and H. D. Palmer, Assistant General Counsel. Mr. Him[illegible] a graduate of Cornell University, class of 1887, and was at one time City Engineer of Corning, N. Y. He first became connected with the New York, Chicago & St. Louis R.R. in 1901 as Bridge Engineer.

Mr. Earle B. Phelps, Assoc. Am. Soc. C. E., Assistant Professor of research in chemical biology at the Massachusetts Institute of Technology, has been appointed Professor of Chemistry and Chief of the Division of Chemistry at the Hygienic Laboratory of the United States Public Health Service, Washington, D. C. Prof. Phelps graduated in chemistry from the Massachusetts Institute of Technology in 1899 and for four years was Assistant Bacteriologist of the Massachusetts State Board of Health, at the Lawrence Experiment Station; he has been Chemist and Bacteriologist of the Sanitary Research Laboratory at the Institute since 1903, and also Assistant Professor of chemical biology. For several years past he has maintained a New York office as a consulting sanitary expert. The Public Health Service was recently authorized by Congress to make an investigation of the pollution of interstate streams, and to this work Prof. Phelps will devote the major part of his time.

## OBITUARY

Alex Z. Newlin, M. Am. Soc. M. E., Mechanical Engineer of the Kewanee Works of the National Tube Co., Kewanee, Ill., died from pneumonia, Oct. 7, at his home in Kewanee. He was born in McKeesport, Penn., 37 years ago. He graduated from the McKeesport public high school in 1895, and after teaching school for three years he entered the engineering department of the National Tube Co., at McKeesport. In 1901 he was transferred to the headquarters engineering department of the company at Pittsburgh, Penn., and in 1908 was promoted to be Mechanical Engineer of the Kewanee works. He is survived by a widow, two children, his father and several brothers

## ENGINEERING SOCIETIES

### COMING MEETINGS

**NATIONAL SOCIETY FOR PROMOTION OF INDUSTRIAL EDUCATION.**
Oct. 19-26. Annual convention at Grand Rapids, Mich. Secy., C. A. Prosser, 105 E. 22d St., New York City.

**AMERICAN MINING CONGRESS.**
Oct. 20-25. Annual convention at Philadelphia, Penn. Secy., J. Calbreath, Majestic Building, Denver, Colo.

**AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.**
Oct. 21-23. Annual convention at Montreal, Que. Secy., C. A. Lichty, 319 North Waller Ave., Chicago, Ill.

**NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.**
Oct. 28. Annual Convention at Washington, D. C. Secy., Wm. H. Connolly, Interstate Commerce Commission, Washington, D. C.

**NATIONAL CONSERVATION CONGRESS.**
Nov. 18-20. Annual meeting at Washington, D. C. Secy., T. R. Shipp, Indianapolis, Ind.

**GREAT LAKES INTERNATIONAL PURE WATER ASSOCIATION.**
Nov. 6-7. Meeting at Toronto, Ont. Secy., Paul Hansen, Urbana, Ill.

**UNITED STATES GOOD ROADS ASSOCIATION.**
Nov. 10-16. Third annual meeting at St. Louis, Mo. Secy., J. M. Rountree, Birmingham, Ala.

**NATIONAL FOUNDERS ASSOCIATION.**
Nov. 19-20. Annual convention at New York City. Secy., J. M. Taylor, 29 So. La Salle St., Chicago, Ill.

# ENGINEERING LITERATURE

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## REVIEWS AND NOTES

## A Study of One Type of Reinforced-Concrete Floor Slabs

Reviewed by MALVERD A. HOWE*

THE THEORY OF THE FLEXURE AND STRENGTH OF RECTANGULAR FLAT PLATES Applied to Reinforced Concrete Floor Slabs—By Henry T. Eddy, Professor of Mathematics and Mechanics, College of Engineering, and Dean of the Graduate School, Emeritus, University of Minnesota, Minneapolis, Minn.: Rogers & Co. Cloth; 6x9 in.; pp. vii + 104; numerous halftone plates and text illustrations. $5.

Several attempts have been made to develop a rational theory for the design of reinforced-concrete flat slab floors, all leading to more or less approximate methods. The six methods for designing the four-way reinforced flat slab, known to the writer, are not in agreement. Three methods require from two to four times the amount of steel required by the other three. The three methods requiring the smaller amounts of steel are based upon the elastic properties of the concrete and steel and probably have for a single foundation the theory of thin flat plates.

Dr. Eddy has based his investigation upon the "fundamental equations of extensional stress and strain in thin flat plates and slabs" which contain the function called Poisson's ratio.

If the assumptions are acceptable that the "actual reinforcement is regarded as distributed into a thin sheet of uniform thickness," that the concrete resists compressive bending stresses only and that the extensions or compressions in one direction are influenced by those at right angles, then the formulas developed by Dr. Eddy are very easy to follow and lead to expressions which are simple in form and easy to apply.

However much one may question the above assumptions there can be but little doubt that a reinforced-concrete slab supported on columns behaves in a manner somewhat similar to a homogeneous thin slab under like conditions of loading. Admitting this to be true, the equations developed by Dr. Eddy are of the proper form, leaving, however, the values of the function representing Poisson's ratio, that one representing the effective area of the steel and the one determining the proper arm of the stress in the steel, to be determined by the designer to fit any particular type of construction.

Unfortunately Dr. Eddy has shown the application of his formulas in detail to but one type of construction, the "standard mushroom" type (Turner's). For this type Poisson's ratio is stated to be 0.5. The accepted value of this ratio for steel is 0.3 and that for concrete 0.1; consequently it requires more convincing arguments than those given on pages 11, 12 and 13 to satisfy the reviewer that this is the average value of Poisson's ratio for reinforced concrete with the special arrangement used in the "standard mushroom" construction.

Inasmuch as the theoretical values found from the formulas using the value 0.5 agree well with experimental results, this is the proper value to use for this function for the "standard mushroom" system, but it appears more logical to simply state that the function is an empirical factor depending upon the qualities of the materials and their arrangement determined by experiment.

Representing Poisson's ratio by K the general formulas for the stress in the steel and the bending moment are as follows:

$$f_s = \frac{(1 - K^3)\, q\, b}{12\,(j\,d)\,\Sigma\,A}\,(3\,x^2 - a^2) \text{ and } M = \frac{(1 - K^3)}{12}\,q\,b\,(3\,x^2 - a^2)$$

All of the quantities are known excepting K, jd and A; jd is the "vertical distance from the center of tension in steel to center of compression in concrete" and A is the "area of cross-section of steel reinforcement per unit width of slab in case it can be assumed to be replaced by a uniform sheet of equal weight." Any errors made in the assumption of jd and A will have a proportional effect upon the values of $f_s$ and M, but a very considerable error may be made in assuming the value of K without seriously affecting the values of $f_s$ and M. Therefore it is not worth while to enter into any arguments concerning the actual value of K.

As stated above the "standard mushroom" type has been worked out in detail and equations given for deflections, stresses in side and diagonal belts, points of contraflexure, points of maximum moment, shears, etc. These equations are very complete and easy to use.

The title of the book is not well taken, as aside from the twenty-odd pages devoted to the development of the general equations, the entire book appears to be a plea in favor of the "standard mushroom" type of construction. The Preface and some ten pages at the end of the book are credited to C. A. P. Turner. Twenty-one pages are taken up with a description and discussion of tests made upon a Norcross slab and a "standard mushroom" slab.

The book impresses one as a very excellent trade publication but it is not easily understood why a price of $5 should be demanded even if, as stated in the Preface, that sum "will be credited in return for it, on the larger treatise which the authors intend to complete as soon as the magnitude of the task will permit."

RAINFALL, RESERVOIRS AND WATER SUPPLY—By Sir Alexander R. Binnie, Past President, Inst. C. E. [Founded upon the Chadwick Trust Lectures Delivered by the Author at the Institution of Civil Engineers in February, 1912.] New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xi + 157; 56 plates and illustrations. 50c., net.

These lectures by one of the leading engineers of Great Britain are chiefly valuable in that they "illustrate some of the salient points connected with" water-works engineering as developed and observed by the author in the course of long practice. The principal subjects treated are rainfall, runoff, consumption per capita, sources and modes of supply, reservoir dams and reservoir outlets, aqueducts and supply mains, the distribution system, valves, meters and house fittings. Aside from the author's personal views on water-works design and construction, the volume contains comparatively little not already in print.

*Director, Departments of Architecture and Civil Engineering, Rose Polytechnic Institute, Terre Haute, Ind.

The tabular and other figures and the examples of design and construction are for the most part drawn from the past, and to be of much more than historical interest need to be brought up to date. Notwithstanding these limitations, the book would be a worthy addition to fany libraries.

## A New Edition of Andrews' "Structures" and a Supplementary Volume

Reviewed by LEWIS E. MOORE*

THE THEORY AND DESIGN OF STRUCTURES—A Textbook for the Use of Students, Draftsmen and Engineers Engaged in Constructional Work. By Ewart S. Andrews, Lecturer in Theory and Design of Structures at the Goldsmiths' College, New Cross, England. Third edition. London, England; Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xii + 618; 290 text figures. 9/-, net.

FURTHER PROBLEMS IN THE THEORY AND DESIGN OF STRUCTURES—An Advanced Textbook for Use of Students, Draftsmen and Engineers Engaged in Constructional Work. By Ewart S. Andrews, Lecturer in Theory and Design of Structures at the Goldsmiths' College, New Cross, England. London, England: Chapman & Hall, Ltd. Cloth; 5x9 in.; pp. viii + 236; 99 text illustrations. 7/6, net.

An earlier edition of Andrews' "Structures" was reviewed in these pages on Apr. 14, 1910. The subject matter through the main portion has not been altered, but some new material has been added in the form of an appendix. The new material consists of a very short paragraph on repetition or variation of stresses. About three pages are devoted to a digest of Stanton's experiments on wind pressure, which give a formula and certain other results deduced from these experiments. The experiments show a certain amount of suction on the leeward side of a roof and another page is devoted to stress diagrams, using this upward or suction pressure on the roof. The next six pages are devoted to an analysis of stresses in curved beams of rectangular cross-section. About five pages are devoted to the drawing of bending moment diagrams by means of a template. Several pages are then devoted to problems illustrating deflections of beams in various special cases, a few pages are given to wind stresses in roof trusses.

In the body of the book the author still persists in the statement, to which attention was called in the previous review, that the economic depth of a plate girder is from one-tenth to one-fifteenth of the span, and in designing plate girders he counts upon one-sixth of the web as flange area, which would not be regarded as safe designing by American engineers. The value for the maximum bending moment on a stiffening truss of a suspension bridge, which the author erroneously gave as $\frac{p L^2}{54}$ in the first edition and which was noted in the previous review, is still given, but the author has added a foot-note stating that with a certain kind of loading the value of the maximum bending moment may be $\frac{p L^2}{32}$.

In general it can be said that the only change from the first edition is in the addition of 27 pages in the form of an appendix.

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The second of the volumes before us is intended to supplement the one just noted. The influence line, omitted in the previous volume, is treated here in some detail, the first four chapters being devoted to it. The first two chapters deal with the application of influence lines to simply supported beams and frames. The author states at the close of the first chapter that if "the whole of an engine is under the line of the influence diagram, it will be necessary only to scale off the ordinate under the center of gravity [of the engine] to get the bending moment for the whole engine." This is manifestly incorrect, as may be seen by taking the influence line for bending moment at any point of a simple beam and assuming, for the sake of the argument, that the center of gravity of the loads on the beam happens to be at the highest point of the influence line. The sum of all the loads would, then, according to the author, be multiplied by the greatest height of the influence line, a manifest absurdity. Chapter II takes up the application of influence lines to trusses and develops a formula for finding the position of loads which produces a maximum moment at any given point. The author fails to carry his analysis to its logical conclusion, which would of course lead him to the "average load" method, but stops short with a formula which would be by no means easy to remember.

The third chapter takes up, first, influence lines for statically indeterminate beams. The end bending moments for fixed ended beams are found by a graphical method. A mathematical treatment is also given and influence lines are drawn for continuous beams of unequal spans. The chapter closes with applications of the influence line method to trusses of two spans and a continuous beam of three spans.

Chapter IV applies influence-line methods to arches and suspension bridges, beginning with a three-hinged arch. In the solution of the parabolic arch the author obtains a maximum moment equal to $\frac{p L^2}{53}$, after making an approximate solution of an equation by plotting. The reviewer believes that the denominator of this fraction should be 54, but has not the time at his disposal necessary to make an exact mathematical solution. The number 53 does not naturally occur in connection with parabolic arches and 54 as well as other combinations of the figure 9 does occur. It should be noted that a difference of 3 units in the fourth decimal place represents the difference between the values of the two fractions. The chapter continues by taking up spandrel-braced arches and two-hinged arches. The closing pages of the chapter refer to stiffened suspension bridges. The author has corrected the error in the maximum bending moment on a stiffening truss, which occurred in the volume to which this is supplemental, and which was noted by the present reviewer when he reviewed the first volume in these columns.

The deflection of trusses is next dealt with, taking up first the deflection in a single-angle bracket in the direction of the load and then treating the general case of deflection in any direction under any set of loads. Equations for giving the depth of a Warren and a Pratt truss for maximum stiffness are given. The depths which the author tabulates for various numbers of panels are considerably greater in proportion to the panel lengths than the experience of American bridge engineers indicates to be economical. The Williott diagram is explained and illustrated.

Chapter VI takes up stresses in frames having redundant members, analyzing by the method of deflections, and closes with a short paragraph on the method of least work. Chapters VII and VIII deal with arches, arch ribs and spandrel braced arches, deriving general formulas for the determination of the thrust for parabolic and circular arch ribs; and treating fixed arch ribs of parabolic and circular form.

Chapter IX treats portals and Chapter X secondary stresses. The author takes up secondary stresses in simple cases, such as roof truss shoes, and shows how the latter may be designed to avoid secondary stresses. He falls into the error, however, of making the gage lines, instead of the gravity lines, of the members intersect in a point. The treatment of secondary stresses in trusses is brief, consisting largely of a digest of an article by Prof. Turneaure, which appeared in "Engineering News" of Sept. 5, 1912. The author does not tell how to avoid secondary stresses, which is what the average practitioner wants to know.

It is perhaps not quite fair to criticise this book by itself as it is intended to supplement a previous volume and the explanations in the previous volume are often referred to. It would seem that the viewpoint of the author has been to emphasize the working of problems rather than the careful study of fundamental principles. The standpoint seems to be that of the mathematician rather than that of the designer of bridges. The mathematical work throughout is given in great detail, but the discussion of results, and the effect of differing conditions on the result, are very meagre. The book gives the impression of theoretical rather than practical knowledge on the part of the author. It would seem that the book could have been great improved had there been more discussion of conditions and had their effect on the theories been explained.

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ROAD MAKING BY CONVICT LABOR—Bulletin No. 1, National Free Labor Association, 832 Broadway, New York City. Paper; 6x9 in.; pp. 48.

This pamphlet is issued to urge the general use of convict labor in road construction and in the work of producing supplies used by the inmates of state institutions. In over half the states of the Union, the system is still in force of leasing the labor of convicts to private contractors at so much per day. The contractors use the convicts in various lines of manufacture often at a large profit. New York was the first state to adopt the "state use" principle of convict-labor employment, limiting the employment of convicts to the manufacture of articles used in public institutions. This was done by the constitution adopted in 1894. Most of the articles

*Associate Professor of Structural Engineering, Massachusetts Institute of Technology.

in the pamphlet relate to the use of convicts on highway work which is common in the South and which is attracting increased attention in the North.

## A Practical Handbook on Steel Designing

Reviewed by JOHN L. HALL*

STEEL DESIGNING—Being "Structural Engineering," Book III. By Edward Godfrey, M. Am. Soc. C. E., Structural Engineer, Robert W. Hunt & Co.; author of "Steel and Reinforced Concrete in Buildings," "Some Mooted Questions in Reinforced Concrete Design," etc. Pittsburgh, Penn.: The Author, Monongahela Building. Leather; 4x7 in.; pp. 492; numerous text figures and drawings. $2.50.

This handy volume will surely find a welcome among those for whom it is intended.

The author having been a student, college instructor, draftsman, inspector in mill, shop and field, and a designer of steel, has aimed to make a book that will be useful to men in these various capacities, and also to the shop foreman. It was therefore necessary for him to cover a wide field—from metal working to specifications and definitions—and it must be said to the author's credit that there is nothing in the book which cannot be easily understood by any of these, while there is much in it that can be read with profit by them all.

The book does not go into the subject of computations as one might assume from the broad title. It has very little to say upon loads and stresses, or upon theoretical phases of designing. It is rather a compendium of practical notes and comments derived largely from the author's experience. The reviewer having devoted some years to designing structural steel for buildings, he turned instinctively upon opening the book to the wind bracing of buildings, and was disappointed to find six pages of familiar illustrations, and one page of context which could be summarized by saying: "This is how these buildings are braced." Anyone equally familiar with bridge designing would probably experience similar sensations upon turning to his favorite subject, and so with other topics.

The book is profusely illustrated with line drawings of steel designs for structures and parts thereof photographically reproduced from "Engineering News" and other reliable sources. In this respect the book is eminently practical, exhibiting for the most part work which has been actually constructed.

The illustrations in general present good practice. Desirable features are pointed out, and bad details receive merited criticism. The author has views of his own upon most subjects and occasionally runs counter to accepted practice. In such cases the reader must exercise judgment in accepting or rejecting the views expressed.

The author points out many faults in specifications, and argues justly in favor of a uniform standard specification for structural steel. Whatever merits the author's specifications may be found to possess, it is not thought that the profession will be quick to adopt the work of any single engineer upon this subject, but rather will look forward to specifications to be prepared eventually by committees of our national technical societies.

The characteristic and helpful thing about the book is that it gives the result of experience rather than the product of theoretical mental processes. It is not often that a man of wide practical experience can bring himself to the point of setting out the results of his experience in an orderly way for the benefit of others, as the author has done. While it might truthfully be said that every subject touched upon in the book is treated more fully elsewhere, yet on account of the compactness and the large number of illustrations, convenience will make a strong appeal to the busy man and especially to the great majority who wish to know something about a subject and do not care to take the time to investigate it thoroughly in a more comprehensive work.

The book is about the size and shape of the Carnegie Steel Co.'s handbook. There are about 190 pages devoted to illustrations and 300 to text. Of the 33 chapters, six are devoted to notes on the general design of various structures, four are on the design of members, eight on details, three on loads and stresses, one each on estimating, inspection and tests, camber, curvature, grade, expansion and contraction, working of steel and iron, preservation of same, illustrations, general engineering data, specifications and definitions, besides an 8-page index.

From a mechanical viewpoint the book is not above criticism. The illustrations need readjustment to their new environment. Many of the letters and figures and some of the titles are upside down. The pages are closely set with rather small type and there is an absence of reference titles at the head of pages. These minor defects, however, may well be overlooked by those in search of practical instruction.

*Vice-President, Purdy & Henderson, Civil Engineers, Henry Bldg., Seattle, Wash.

## Sea-Coast Protection

Reviewed by WILLIAM W. HARTS*

COAST EROSION AND PROTECTION—By Ernest R. Matthews, Borough Engineer of Bridlington (England); author with Prof. Hy. Adams of "Reinforced Concrete Construction" and with T. G. Howes Thomas of "Logarithms and Trigonometry for Engineers and Surveyors." London, England: Charles Griffin & Co., Ltd. Philadelphia, Penn.: J. B. Lippincott Co. Cloth; xiv + 147; 74 text illustrations and 34 plates. $3.50, net.

Probably nowhere else in the world has the subject of protection of coasts against erosion by sea action been given the attention it has received in England. This has arisen partly from the friable character of the material composing some of the more exposed English coasts, partly from the great "fetch" of the waves during storms, and partly from the high value of the land adjacent to some of these coasts owing to the unusual density of population.

In this country the subject has been given but little study for the cases are comparatively few where the extent of the damage would warrant the very expensive structures usually found necessary. Among these cases may be noticed the sea wall at Galveston, the shores of Lake Michigan within the limits of Chicago, and certain places on the New Jersey coast near several of the prominent summer resorts. For this reason Mr. Matthews' book has but little more than academic interest in this country.

The book is composed of three main parts which may be briefly discussed under the heads of Erosion, Sea Walls and Groynes.

The portion dealing with erosion treats first of the action of waves on the coast line in a very brief and general way, and then describes at some length the various coasts of England where erosion has been especially injurious. The information is not of very wide interest. This portion is followed by the description of a number of well known sea walls built for coast protection, most of which are from English experience, and a few are taken from the coast of Holland. The engineering profession is already familiar with many of these structures.

The portion of the book referring to groynes as an additional means of protecting and rebuilding the foreshore in front of sea walls and elsewhere refers at some length to these structures, but the subject of groynes has been given attention for many years and much has been written on the subject already. There does not seem to be much new information under this head.

The author's experiments on the action of sea water on concrete have some interest and contribute to the old controversy between those who think it injurious and those who do not. The author states that sea water has a destructive action on Portland-cement concrete and recommends the mixing of concrete with fresh water where it must be used in the sea and the ageing of it in the air whenever possible. He suggests mixing pozzuolanic material with the concrete or the use of cement without alumina. His experiments are apparently few in number and of short duration and may be objected to by some as inconclusive.

The photographs of various sea walls, particularly those showing wave action, are very interesting and the text is further illustrated by a number of well chosen cuts.

The book does not go very deeply into any part of its subject and taken as a whole is not particularly valuable, except, perhaps, as an incomplete but convenient and readable compilation of information of this kind.

THE ROLLING MILL INDUSTRY: A Condensed, General Description of Iron and Steel Rolling Mills and Their Products—By F. H. Kindl, Engineer, Pittsburgh, Penn. Cleveland, O.: Penton Publishing Co. 6x9 in.; pp. 76; 27 illustrations. Cloth, $2; flexible leather, $3.

Anyone unacquainted with the operation of rolling mills yet who desires a general idea of this branch of the fron and steel industry, will do well to read Mr. Kindl's book. It is written in a very plain and simple manner, beginning with a general description of rolling mills and their products, with a chapter dealing with the manufacture of wire and the products of wire, such as nails, spikes, netting, rivets, screws,

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staples and tacks, and another chapter on the tube and pipe industry. A chapter entitled "Finished Products" treats rapidly of the finished forms which leave the mill. These are divided into four groups: (1) bars, rods, wires; (2) structural shapes, rails, splice bars; (3) plates, sheets, and (4) forgings, armor plate, axles, wheels, tires and drop forgings.

Charts showing the method of production further simplify the explanation embodied in the text. For those interested in the economics of the iron industry, a table is given showing a comparison of the factors which dictate the production of pig iron in the United States, Great Britain and Germany.

## Steam Turbines

Reviewed by H. E. LONGWELL*

THE DESIGN AND CONSTRUCTION OF STEAM TURBINES —A Manual for the Engineer. By Harold Medway Marton, author of "Statically Indeterminate Structures and the Method of Least Work." London, England: "Engineering." New York: Longmans, Green & Co. Cloth; 8x11 in.; pp. viii + 372; 523 illustrations, including 24 folding plates. $8.50, net.

This work is largely a condensation and re-arrangement of a series of articles contributed by the author to the columns of "Engineering" (London) and published in that journal during the past few years. The book is to be commended especially for its mechanical make-up. The unusually large and clear type, the liberal spacing between the lines, and the dead finish of the paper combine to make the pages restful to the eye. This is no small advantage in a book that demands the unflagging, concentrated attention of the reader.

The first half of the book is taken up with principles of design—to some extent theoretical, but consisting largely of empirical formulas and diagrams without discussion as to their probable rationalness. The Mollier diagram is used for determining the "heat drop" and steam quality resulting from adiabatic expansion. There is a good deal of fairly complicated mathematical work in this section of the book, but it does not seem to be connected up logically with the general subject matter.

Chapter XVI, on Thermodynamic Principles, is the conventional chapter on entropy, without which no author of a book on heat engines seems to think that his treatise is complete. The treatment of this subject is, if anything, a little less lucid than is usual. In discussing the entropy-temperature diagram, the author calls attention to the "remarkable" properties of the curves, in that the area included under the curve between any two ordinates is equal to the heat added during a change of condition of the substance defined by the points where these ordinates cut the curve. It is a rather loose use of language to say that an area is equal to a quantity of heat, but at any rate considering that the curve is expressly constructed to show this quantity graphically, it is difficult to see why the fact that it does show it should be at all "remarkable."

We are informed on page 25 that a certain type of turbine blade was arrived at because it was found that **"as applied to aëroplanes,** it showed a much higher efficiency" than blades of another type illustrated. (Black face type mine.)

The author has a happy faculty of putting some of his formulas in rather unusual forms which are easily remembered. For example, the formula for tangential stress in a rotating steel ring is given as

$$2\left[\frac{d}{10}\right]^2 \times \left[\frac{N}{100}\right]^2$$

in which d is the diameter in inches and N the number of revolutions per minute. It is almost impossible to forget this expression, and it is sufficiently accurate for all practical purposes.

There are short chapters on geared turbines and condensers which do not cover any new ground.

It is in the last half that the book shines particularly. This part is devoted to detailed descriptions of several different types of standard turbines as actually manufactured by leading English and Continental builders. The illustrations are copious and dimensions are given with unusual liberality. As these illustrations are made from practical and successful machines, this part of the work should prove interesting and helpful to anyone who is a student of the subject.

The methods of proportioning turbines as laid down in the first part of the book are disappointing on first reading because they appear to be to a great extent purely arbitrary. Still, if a capable designer were to analyze these methods, and satisfy himself that they are rational, they might be useful as suggesting "short cuts" for making preliminary layouts.

Taken as a whole, the book is a creditable addition to the subject.

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## Telegraph Equipment

AMERICAN TELEGRAPH PRACTICE—A Complete Technical Course in Modern Telegraphy, including Simultaneous Telegraphy and Telephony. By Donald McNicholl, M. Am. Inst. E. E., Member of Engineering Staff, Postal Telegraph-Cable Co., of New York. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xvi + 507; 421 text illustrations. $4, net.

Mr. McNichol has set forth in this volume far more details of American telegraph equipment than anyone has attempted heretofore. In spite of the title, however, there is comparatively little about telegraph practice except as is necessary to an understanding of the apparatus employed. The notable exceptions are in the sections discussing speed of signaling, testing of quadruplex systems, preventing inductive disturbance and combined telephone and telegraph service. There is nothing, as we might perhaps expect, about organization or general operating methods, traffic peaks, effect of deferred messages, operators' hours, relations of branch-office and busy trunk lines, precedence governing breaking in caling, etc., combined railway dispatching and message transmission, etc. The author has been able, naturally, to give the most particulars of the Postal company's apparatus and equipment, but wherever details are available of equipment of the Western Union company and the British Post Office, they have been used also.

About a quarter of the text relates to elementary theory of electricity and magnetism, to properties of circuits, primary and storage batteries, direct-current generators (alternating-current generators are passed over), motors, rectifiers, etc. It might be expected that one who could present descriptions of apparatus in such a wealth of detail would not at every point secure the happiest presentation of the very elementary theoretical discussions. Viewed as a whole, the elementary parts are good, but not quite as satisfactory as existing treatises on rudiments alone. Experts, in writing or talking to each other, frequently drop into looseness in the use of terms which is confusing to the beginner, as for instance when it is said (p. 119) that an alternating current of high frequency has large capacity and high self-induction. What should be said, of course is that the actual effect of capacity and self-induction in the circuits becomes greatly pronounced with high-frequency currents. (The author explains in his preface that his book is for working telegraphers of rather limited education.)

Careless proof-reading in a few places confuses the meaning also, as where semicolons displace commas.

That part of the book dealing most immediately with telegraphy, describes first power-board wiring, and then simple Morse circuits. After this come, in order, lightning arresters, line switchboards, tests (for faults, line characteristics, etc.), repeaters, duplex and quadruplex instruments, branch-office equipment, calls and annunciators, alternating-current telegraphy ("phantoplex"), and automatic and printing telegraphy. Excellent chapters are appended on minimizing the induction from neighboring high-tension lines, and on the simultaneous use of lines for telegraphy and telephony; the book concludes with specifications for copper and iron wire, aërial, underground, submarine and office cables, and specifications for construction of high-tension power lines above telegraph wires, etc.

SOLUTION OF RAILROAD PROBLEMS BY THE SLIDE RULE —By E. R. Cary, M. Am. Soc. C. E., Professor of Railroad Engineering and Geodesy, Rensselaer Polytechnic Institute. New York: D. Van Nostrand Co. Cloth; 4x6 in.; pp. ix + 136; 43 text figures. $1, net.

While evidently designed to teach engineering students facility in solving railway-curve problems and in using a slide-rule this little book will be found to be of real practical value to the field engineer. It is of very handy size and gives clearly and concisely the principal formulas for the solution of the railway curve and track problems.

The formulas have been worked into such form as to make them particularly adaptable to slide-rule computations, and if slide-rule results should not be close enough for much real fieldwork the formulas are equally adapted to logarithmic computations. The notation used throughout is the same as that used in Allen's "Railroad Curves and Earthwork," to which this little book makes a valuable supplement. Formulas and explanations for the solution of easement curve and earthwork computations by slide-rule are included. A table of trigonometric formulas forms an appendix.

# Rock-Asphalt Products

Reviewed by S. WHINERY*

NATURAL ROCK ASPHALTS AND BITUMENS; Their Geology, History, Properties and Industrial Application—By Arthur Danby, Chemist and Public Consultant on Rock Asphalt and Bitumen. New York: D. Van Nostrand Co. Cloth; viii + 244. $2.50, net.

Mr. Danby's book has a clear field in engineering literature. Delano's little book on the same subject which appeared some twenty years ago is out of print and even if obtainable would not be, at this late date, of much practical value. There have appeared in the meantime, it is true, a few papers, articles and chapters of books, dealing with some phases of the general subject, but nothing attempting a full and systematic treatment.

While the use in this country of European rock asphalts for paving, never very extensive, has steadily declined, and its employment for other purposes is not very large (the importation of all asphalts from Europe being only 10,656 long tons in 1912) the matter is still of sufficient importance to claim the attention of the American engineer, who will doubtless welcome this book to his library.

In ten pages of introductory matter the author deals chiefly with the vexed question of the nomenclature of bituminous materials. He proposes that all natural bitumens and derivatives from them shall be called bitumens; the artificial or pyro-bituminous he would call pitches, while the name asphalt would be applied only to "all such substances that are impregnated—as distinct from being merely mixed—with either bitumen, pitch or a mixture of the two." This is a return to and broadening of the definition of asphalt originally claimed by Delano and the promotors of the rock asphalt industry. He would call a material made of an artificial mixture of bitumen or pitch with grit or crushed stone, macadam, presumably including under the name our American sheet asphalt pavements. It is hardly necessary to say that his system of nomenclature will not be acceptable to American authorities on the subject.

The several chapters of the book are successively entitled: Geology of bitumen and rock asphalt; appearance and physical structure; history and ancient use; modern exploitation of rock asphalt; sources of rock asphalt and bitumen; American deposits of bitumen; extraction and preparation of rock asphalt; tests and analyses; physical properties of rock asphalt; the carrying out of rock asphalt work; the carrying out of rock asphalt mastic work; macadam roads; and, other uses of bitumen.

The earlier chapters, relating quite fully and in detail to the history and development of the rock asphalt industry, the sources of the material and methods of mining and preparing it, are exceedingly interesting. The two chapters on American deposits of bitumen are not notable for either completeness or accuracy, particularly as regards the extent and importance of Cuban deposits. The 48 pages devoted to the practical use of rock asphalts in structural work will be of most utility to the American engineer.

Upon the whole the book is a very interesting one to read and will be especially so to the American engineer who has not had opportunity to visit the rock asphalt mines and works abroad and thus to acquaint himself with their many interesting details.

The reader will be likely to note that the author's statements are not always clear and consistent, particularly with reference to the classification of bituminous materials under his system of nomenclature. As an instance, the uninformed reader of the paragraphs beginning near the bottom of page 158 might get the impression that Trinidad asphalt belongs to the rock-asphalt class.

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AMERICAN STANDARD FOR FLANGED FITTINGS, Standard and Extra Heavy Pressures—Adopted Sept. 17, 1913, by the Committee of Manufacturers on Standardization of Fittings and Valves; Secretary, W. H. Douglas, 30 Church St., New York City. Paper; 7x10 in.; pp. 16; illustrated.

It will be remembered that about 1894, under the auspices of the American Society of Mechanical Engineers and the Master Steam and Hot Water Fitters Association, the manufacturers of flanged pipe fittings eliminated the existing confusion in various designs for ordinary weights by the adoption of the "Am. Soc. M. E. Standard." In 1901, the same manufacturers attempted to eliminate similar confusion in extra heavy fittings by adopting what was known as the "Manufacturer's Standard" for flange dimensions and bolting. The American Society of Mechanical Engineers and the Master Steam and Hot Water Fitters Association continued the study of flanged fittings, and in 1912 adopted the "1912 U. S. Standard" for low pressure, standard and extra-heavy pressure work. The manufacturers discovered that the new standard offered them differd in so many ways from dimensions used in the trade that they did not care to accept it. But they saw the need of revision of their designs on account of low factors of safety, and adopted the "1912 Manufacturers' Standard." There was a little sharp contention about the merits of both proposals and a deadlock for a short time, but finally through the influence of H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Co., New York City, and Chairman of the American Society Committee on Flanges, the differences were compromised in designs covered by this "American Standard of 1914." This has been adopted by the manufacturers of 90% of such equipment in this country and by the American Society Committee. The council of the Society has not formally approved this report, but is expected to do so. Certain differences still exist between this and the standard accepted by the Master Steam and Hot Water Fitters Association.

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# Some Public Utility Principles

REGULATION, VALUATION AND DEPRECIATION OF PUBLIC UTILITIES—By Samuel S. Wyer, M. Am. Soc. M. E.; author of "Treatise on Producer Gas and Gas Producers." Columbus, Ohio: The Sears & Simpson Co. Flexible leather; 6x9 in.; pp. 313; 47 illustrations. $5, net, postpaid.

Mr. Wyer seems to have a habit and a hobby, each good, and to have combined the results of a pursuit of the two into this book—which contains much that is also good. The habit is to read widely on a given subject, digest the salient points on index cards and arrange the cards systematically. The hobby is to reduce data and criteria to neat and clear diagramatic form.

The author says his aim has been to present "an unbiased discussion and concise compilation of the pertinent economic, engineering and legal facts relating" to "the rights" of both the Public and Public Utility Corporations. He adds that "my own argument is fortified with numerous digested opinions of experts and judicial decisions, many of the latter being from the United States Supreme Court. The book is, therefore, the summation of the amassed thought and experience of many minds covering a period of many years."

After a general introduction and some fundamental definitions, the author takes up in succession the economics of utility problems, various phases of utility regulation, depreciation, valuation, going value, etc., and the principles governing the cost of utility service. Various engineering data are then presented, and the book is closed with a few reference tables, a bibliography (really a source list), and name and subject indexes.

Outside of the 33 pages of "Engineering Data," and the author's numerous diagrams, most of the volume is direct quotation from various authors and from court decisions. Although much skill has been shown in grouping these quotations and in filling missing links with definitions and opinions by the author, the result of the plan is a rather choppy or disjointed collection of definitions and opinions, classified under certain main heads. As the quotations stand in the pages a decision of the United States Supreme Court is given no more weight by the author than that of some state court or utility commission or of some writer on law or economics. To find who the authorities cited are one must turn to the bibliography in every case, which is often trying because the thin leaves stick together.

The most serious weakness of a book composed, like this one, so largely of short quotations is that taken out of their context and with but little connecting text or explanatory comment the quotations lose force or are liable to be misleading.

A large part of the space devoted to engineering "data" is well nigh wasted with mere text-book definitions and descriptive notes that have no place in a book of this sort. Thus:

LIGHT BEAM—A collection of parallel rays is called a beam.

SEDIMENT—[In water.] This may be sand, fragments of plants or animals or ferric oxide.

Of three chapters on depreciation two are taken up with electrolysis. Here the author reprints considerable portions of several papers on the subject, throwing his book all out of balance. Elsewhere he inserts a number of pages of halftones showing forms of life destructive of wood.

Some of the diagrams are more ingenious or curious than useful.

To most engineers the chief value of the book will lie in the classified citations of and references to authorities. Most of the remainder of its contents, save some of the diagrams and tables, might have been omitted with little loss

to no one and considerable reduction in the size and cost of the book. Finally, the author's skill in condensation, in arrangement and in the preparation of diagrams deserves commendation, as does the work of the publisher.

## Metallurgy as a Whole

Reviewed by WILLIAM CAMPBELL*

GENERAL METALLURGY—By H. O. Hofman, Professor of Metallurgy, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiii + 909; 836 illustrations. $6, net.

Looking over the standard works on Metallurgy it is surprising to find that there are few books treating of the subject as a whole. For many years Sir William Roberts-Austen's Introduction to Metallurgy was unique and in 1910 it was brought up to date by Harbord. In this same year appeared Fulton's Principles of Metallurgy, an excellent work, in which the physical-chemical side of the subject first received the attention it deserved.

The present volume aims to cover the field of general metallurgy as a whole, under the following heads: Properties of Metals, Alloys, Metallic Compounds, Ores, Fuel, Refractory Materials, Pyrometallurgical, Hydrometallurgical and Electrometallurgical Processes and Apparatus, Mechanical Metallurgical Operations, Metallurgical Products, Economic Considerations.

To the metallurgist and advanced student the book will be welcome as a fitting introduction to the detailed study of the metallurgy of iron, copper, lead and silver, gold, zinc, etc., all of which are covered by special volumes. In fact this volume is the first of a series by Professor Hofman, covering copper, iron and steel, lead, etc. And from this standpoint the first few chapters on metals, alloys and metallic compounds are of special interest.

Of more general interest are the chapters on fuel and refractory materials. The section on pyrometallurgical processes and apparatus deals in a very clear manner with roasting and roasting furnaces, followed by an excellent discussion on slags, and then takes up smelting in the various types of furnaces, blast furnace, reverberatory, crucible, retort and converter. Then follow two short chapters on hydro- and electro-metallurgical processes and apparatus, giving a general idea of the principles of lixiviation and precipitation and amalgamation, and of electrolytic work.

To the engineer, however, it is the mechanical side of the subject that appeals. In the old days a metallurgical plant was generally characterized by a lot of small units in which metallurgy rather than engineering was the prime factor and here our metallurgy was developed. Anyone visiting one of our modern plants, be it an iron and steel works or a copper smelter, is immediately struck by the fact that the efficient handling of material in quantity is now the important thing, and here we have to acknowledge that the engineer must of necessity take the main credit. Fifty-ton ladles and ingots of 150 tons, tilting furnaces holding 250 tons of metal, blast furnaces producing 600 tons of metal a day, to say nothing of our huge forges and presses and rolling mills, are the products of the engineer.

A book that emphasizes the mechanical processes follows the tendency of present-day metallurgical practice and here we have 350 pages devoted to the mechanical side of the subject. This section is subdivided into Ores, Metal Alloys, Liquids and Gases. A clear account is given of the crushing and grinding of ores in breakers, stamps, rolls, pans and mills, followed by classification, concentrating and briquetting. Next comes the mechanical treatment of metal by rolls, hammers and presses. Under the heading of Liquids, the author discusses pumps, mixers and filtering devices. Under Gases come air-supply and method of producing blast, preheating and drying of air and purification of gases by the various methods.

The book is uniform with others in the series issued by the same publisher. It is well illustrated and printed and a distinct contribution to metallurgical literature.

SAFETY FIRST—By George Bradshaw, Safety Engineer; author of "Prevention of Railroad Accidents." New York and London: McGraw-Hill Book Co. Stiff paper; 5x8 in.; pp. 130; 99 illustrations. 50c. net.

The many railroad accidents continually occurring and the army of lives which they annually claim, should serve to strengthen the slogan which forms the title of this little book. With just enough text to give point to its 99 illustrations, the book is a pictorial warning to all railroad yard and shop men to not be foolish in the performance of their many operations, each with its element of danger. There are many photographs showing the right and the wrong method (as regards safety) for performing the principal yard operations, e.g., switching and coupling, and there are illustrations of safety devices applicable to the machine shop and to the rolling stock. It is a little book, but a big subject.

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## The Disposal of Trade Wastes

A TEXT-BOOK ON TRADE WASTE WATERS: THEIR NATURE AND DISPOSAL—By H. Maclean Wilson, Chief Inspector, and H. T. Calvert, Chief Chemical Assistant, West Riding of Yorkshire Rivers Board. Philadelphia, Penn.: J. B. Lippincott Co. London: Charles Griffin & Co., Ltd. Cloth; 6x9 in.; pp. xii + 340; 74 text illustrations, including 22 plates. $5, net.

The names and the wide experience of these authors in the control of the discharge of trade wastes into waters within a great manufacturing district are in themselves no small guarantee of the value of their book. The authors state that their object has been to present in "concise form material which has been gathered in many years' experience of the working of the Rivers Pollutions Acts," and that they have sought to do this by so describing trade processes "as to show the origin and nature of polluting waste liquids" and "the means which have been found useful in" their purification.

After the historical and legal review so familiar to readers of British books on sewage treatment, the authors take up in succession wastes from the coal trade, gas manufacture, brewing and distilling industries, leather, paper, textile and miscellaneous trades. The textile trades are given more than a hundred pages. Following the chapter on specific trade wastes and their treatment is one on pumps, screens, tanks, filters, etc., another on the discharge of trade wastes into public sewers (on which there is much to be said regarding British experience and conditions) and finally a chapter on methods of analysis and limits of impurity.

Bibliographies at the end of each chapter are valuable features of the volume. Illustrations from trade catalogs are a minor blemish, but these and line cuts together aid materially in understanding the devices described. The value of the book would have been increased had more been given in the way of experiment and practice elsewhere, and had there been more in the nature of general summary and conclusions, but the book is exactly what it pretends to be, and as a description of problems and their solutions which have come within the experience and observation of the authors, it is a valuable addition to the books on the important and troublesome question of the disposal and treatment of trade wastes.

LABORATORY MANUAL OF TESTING MATERIALS—By William Kendrick Hatt, M. Am. Soc. C. E., Professor of Civil Engineering and Director of, and H. H. Scofield, Assistant Professor in, the Laboratory for Testing Materials of Purdue University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 135; 29 text figures. $1.25.

About one-third of this book is composed of description of testing machines and instruments, definition of terms, statement of phenomena appearing in mechanical testing, etc. The remainder, the main part of the text, is a systematic set of instructions for making all the common mechanical tests; on metal, on wood, on cement, on concrete aggregate and a road-metal. Appended sections contain a compilation of formulas, a table of required qualities of iron and steel and the full text of the cement specification (both of the American Society for Testing Materials), sketches of standard forms of testpiece for steel, and a table of strength figures.

The book appears to be useful for instruction purposes exclusively. The general information contained in the first part of the book is rather too short and sketchy for any but the college student's use, and, of course, the synopsis of tests also is of use only in the college laboratory. While the book thus does not appeal to the engineer, many laboratory instructors are likely to find it a useful tool in handling their testing classes.

CONCRETE ROADS AND PAVEMENTS—By E. S. Hanson, Editor "The Cement Era"; author of "Cement and Tile." Chicago, Ill.: The Cement Era Publishing Co. Cloth; 5x8 in.; pp. 227; numerous illustrations. $1.

So much interest is felt by engineers and others engaged in road construction, in the use of concrete as a road material, that a first-class and authoritative work on this subject should meet a wide sale. The present book, as the author himself says in his preface, "is frankly a compilation." An engineer who is himself fairly well posted on the use of concrete for road construction may find the book useful for reference, especially as it contains a number of the specifications which have been adopted where concrete paving has been largely used on roadways. The layman or the undiscriminat-

ing engineer, however, will be more or less puzzled to know what constitutes good practice in concrete road work, in view of the wide variation in practice described in this book. The most valuable part of the book is its record of the work which has actually been done by various cities and counties in the construction of concrete roads.

## A German Book on Harbors and Docks

Reviewed by WILLIAM W. HARTS*

SEEHAFENBAU—By F. W. Otto Schulze, Professor des Wasserbaues an der Technischen Hochschule in Danzig. Vol. II. Ausbau der Seehafen. Berlin, Germany: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. x + 523; 574 text illustrations. 24 marks.

The volume entitled Sea Por Works (See hafen bau) by Prof. F. W. Otto Schulze, is an excellent exemplification of the thoroughness and care for which the German technical book is so widely and so justly praised. It represents the second part of a larger book on the construction of seaports (Ausbau der Seehafen) and is composed of four chapters, each of which is subdivided into several parts.

The first chapter deals with breakwaters, moles, training walls and piers. It covers first various types of breakwaters and piers having steep sides, such as the timber breakwaters at Rival, the timber-crib breakwaters in the Great Lakes in this country, and breakwaters partly of wood and stone, such as those at Great Yarmouth and Libau.

Breakwaters built of masonry walls with stone or concrete hearting and more particularly those founded on concrete placed under water in sacks or tremies are next described at length with many examples, among which are noticed again several designs used on our Great Lakes. Further examples are taken from English ports, such as those at Blyth, Aberdeen, Newhaven and Sunderland.

Concrete block construction is then taken up and descriptions are given of the well known breakwaters in which both inclined blocks are used, such as in the Colombo breakwater and those where the blocks are set vertically as at Ymuiden. Recent experience in floating concrete caissons is also given at some length with reference to several examples where this method has been successfully used.

The second division of the first chapter describes moles and breakwaters with sloping sides and includes among others many stone breakwaters such as that at Delaware Bay. It includes a discussion of the action of waves on such breakwaters and describes in much detail the designs and methods of construction of many of the important breakwaters of this kind in various parts of the world. It also includes those built partly of random stone and partly of masonry or concrete blocks such as the breakwaters at Sandy Bay, Cette and Naples.

This division of the chapter is followed by descriptions of breakwaters for combined types of construction where the foundation is of random or sorted stone and the superstructure is of concrete or masonry. The use of cellular concrete blocks, which has been increasing of late, is very fully described.

The outer ends of all moles and piers when exposed to storms are often points of heavy sea attack and usually require great strength. The next division of the chapter treats of these pierheads and illustrates various methods of construction with references to existing works, showing the method adopted for strengthening such outer ends.

Probably the most valuable part of the first chapter is that which describes the method of handling the construction of such works as have been mentioned before. This part is stated in much detail and contains many valuable suggestions for both designing and constructing engineers.

The second chapter deals with bank protection, dolphins and anchor-buoys. Various methods of holding the banks against sea-action, including the construction of landing places, are described, followed by a discussion of the calculations for the construction of quay-walls which in its turn is followed by descriptions of various classes of quay walls on piles, on concrete and on masonry foundations.

Attention is called to the many classes of cellular concrete work and floating concrete caissons which have been recently found satisfactory. A part of the chapter offers many useful hints in the matter of such structural details as fender-piles, ladderways, mooring-posts, etc. The latter part of the chapter is devoted to pile-dolphins and various kinds of anchor-buoys.

The third chapter deals with wharf facilities such as track arrangements, sheds and warehouses in commercial ports. Warehouse construction, including grain elevators, is gone into at considerable length and with much detail.

The fourth chapter deals with loading and unloading devices and other mechanical port appliances. Detailed descriptions are given first of various kinds of unloading cranes, elevators and capstans, etc. Attention is paid to various mechanical devices for unloading ships to shore, those for loading ships from the shore, and those used from ship to ship.

The work is thoroughly illustrated with over 500 cuts showing the practical application of the principles expounded. These cuts are unusual in their clearness. The contents of the book are arranged in a systematic and logical sequence that will be appreciated by the technical reader. Although the references are mainly to structures in foreign countries, engineers in this country would be much helped by the many excellent suggestions offered and descriptions of existing works whenever they have any construction of a similar character under their charge.

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THE ELEMENTS OF SPECIFICATION WRITING—A Text-Book for Students in Civil Engineering. By Richard Shelton Kirby, Professor of Civil Engineering, Pennsylvania College. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. vii + 125; $1.25, net.

A better and more concise statement of the character, contents and purpose of this book than the author himself has given in the preface would be beyond the power of the reviewer. The author writes substantially as follows: This is a text-book on the art of specification writing, not a collection of specifications, and is the outgrowth of a series of lectures to the senior class in civil and sanitary engineering in the Sheffield Scientific School of Yale University.

The text treats of the fundamentals of a contract—particularly of a construction contract with its attendent plans and specifications; advertisement and information for bidders; essentials of a proposal and methods of bidding; general clauses; practical suggestions on specific (or technical) clauses, and a classified list of references, largely to recent articles in the more readily accessible technical journals.

General clauses of specifications are given thorough exposition, from the engineer's viewpoint. Many interesting cases illustrating their application to actual construction work are cited and discussed. Numerous and varied model clauses are quoted. Outlines of specific clauses for nine simple construction projects are given to assist the novice who writes his own specifications. Such in brief is the author's outline of his own book, and upon examination we find it to come fully up to the outline.

The text is admirably well written, and the typography is excellent. Many pitfalls not only of the beginner, but often of the experienced engineer, are interestingly brought out, and the often overlooked need of absolute fairness to the contractor is well emphasized. Apt quotations and illuminating incidents from recent technical literature add much to its readability. The reference list of articles in recent technical journals on contracts, contractors and specifications is evidently well selected and systematically arranged, and alone makes this little book worthy of a place in any engineer's library.

PURE IRON VS. COPPER-BEARING STEEL: A Brief for the Plaintiff, with Historical Data Bearing upon the Development of Rust-Resistant Metals in the United States—By Allerton S. Cushman, Director. Washington, D. C.: Institute of Industrial Research. Bulletin 5. Paper; 6x9 in.; pp. 47.

During the past few months several articles have been published in various metallurgical journals putting forth the theory that a small percentage of copper in steel made it resistant to corrosion. If this is indeed true, the discovery is one of great importance since a very considerable proportion of commercial steel at the present time contains small amounts of copper and the addition of copper to steels not containing it in the small amount required would be both easy and inexpensive. The above pamphlet on this subject by Dr. Allerton F. Cushman, Director of the Institute of Industrial Research, Washington, takes the ground that the claims made for copper in steel as an inhibitor of corrosion have no good ground. Mr. Cushman also defends iron made with the lowest possible percentage of impurities as probably the best metal to resist corrosion thus far produced. He gives an interesting historical summary of the recent literature discussing the corrosion of irons and steels.

An itemized summary of all the bids for the construction of the dual subway in New York City, received by the Public Service Commission of the First District from Oct. 27, 1910, to

Aug. 19, 1913, has been compiled by the General Contractors Association (51 Chambers St., New York City) and is published as a supplement to the bulletin of the Association for September, 1913. Including typical cross-sections of the subway, the supplement contains slightly over 100 pages. There is also a folding map. The plan of tabulation includes first the quantities, then in succession the unit, the classification by kind of work or materials and the price and amount for each item. This information is given by bidders and the total of the bid by each contractor is also given.

## Safety of Industrial Workers

Reviewed by R. R. POTTER*

SAFETY METHODS FOR PREVENTING OCCUPATIONAL AND OTHER ACCIDENTS AND DISEASE—By William H. Tolman, Director of the American Museum of Safety, and Leonard B. Kendall. New York: Harper & Brothers. Cloth; 6x9 in.; pp, viii + 422; 69 illustrations and 31 diagrams. $3, net.

SAFEGUARDS FOR THE PREVENTION OF INDUSTRIAL ACCIDENTS—Edited by David Van Schaak. Second edition. Hartford, Conn.: Aetna Life Insurance Co., Accident and Life Liability Department. Paper; 6x9 in.; pp. 187; 168 text illustrations. 50c., net.

The authors present this book on "Safety" as the only comprehensive work on the subject in the English language. It adds practically nothing to what has already been published in technical and other periodicals but claims a place in literature as a collection into one volume of current knowledge on the prevention of industrial accidents. It will appeal to that portion of the general public which has awakened to the importance of this subject of industrial safety, and as a handbook of practical information it will be of value to those directly engaged in the various industries, through its descriptions of the thorough methods for securing safety employed by some of the larger corporations.

Part I, on General Conditions, comprises three chapters on the Philosophy of Safety, Neglected Factors and the Working Place. The Philosophy of Safety reduced to its lowest terms seems to be that it is much cheaper to prevent accidents then to pay damages.

It is a surprising thing to note in this chapter that Mr. Tolman has arrayed himself with those who set up a straw effigy of what they imagine to be the modern movement for industrial efficiency and then kick it over in triumph.

> In all the talk of efficiency which is flooding the country, experts overlook the human element. Efficiency which concerns itself merely with speeding up the man so as to approximate the precision of the machine, requiring one motion where he made two before, will more and more tend to make the man of not much more value than the cog on the wheel. * * * True efficiency must rest on accident prevention, improved hygiene and mutuality.

It is amusing to the reviewer of even a small number of books to see how the particular penny of each successive author hides the sun for him. Another place in the same chapter where the authors go out of their way to make a mistake is where they state that "impure water may not always produce typhoid, but almost invariably does produce stomach and bowel disorders."

Under the head of Danger Zones, Part II includes chapters on yards, walks, railings and hoists; cutting and grinding tools; illumination; fire, transportation; safety committees; iron and steel; mines and mining; electricity; general aids to safety, and organized effort by employers. It appears that "danger zones" is a term of considerable scope. The first five chapters listed are made up largely of emumerations of means and methods of obtaining greater safety in the various fields considered. A few statistics are given of classified accidents and of the decrease of accidents following from the introduction of the safeguards. These chapters are written in a somewhat monotonous style and will be found rather dry reading to anyone not vitally concerned.

One of the most interesting chapters is that on Safety Committees which explains the organization of the committees of safety of the United States Steel Corporation and of the Pennsylvania R.R. Co. Further information on this subject is included in the chapter on Iron and Steel. The Chapter on Mines and Mining deals largely with the safeguards and safety methods of the H. C. Frick Coke & Coal Co., which it is stated have been endorsed and commended by the U. S. Bureau of Mines. Similarly the chapter on electricity consists for the most part of a description of the precautionary methods of the New York Edison Co. The last paragraph of this chapter in particular could scarcely be improved upon by the Edison Co.'s own publicity man.

The chapter on General Aids to Safety gives statistics of the causes of industrial accidents taken from the annual report of the North German Iron & Steel Association. These are followed by some discussion of the causes of accidents. Considerable emphasis is placed on the importance of creating a proper mental attitude among employees toward the subject of safety and various methods for developing this attitude are outlined. The chapter on Organized Effort by Employers consists chiefly of an account of the efforts toward accident prevention of the National Electric Light Association, National Metal Trades Association, National Association of Manufacturers and some of their member companies.

Part III, on Industrial Hygiene, has chapters on committees on sanitation, industrial poisons, chemical industries and shop sanitation. In the first chapter, the organization and work of the sanitation committees of the U. S. Steel Corporation and the Tennessee Coal, Iron and Railway Co. are discussed.

Part IV on Social Welfare is of more general interest than the earlier sections of the book and appears to have been more carefully or at least more intelligently prepared. At the same time one questions why so much space should be given to such subjects as the education of apprentices, vocational schools, etc., in a book on safety to workers. In the chapter on Something More Than Wages, it begins to dawn upon the reader that Safety, in the sense in which it is used by the authors, is not at all confined to the usual field of industrial safety. It is rather a viewpoint, from which to regard all commendable activities bearing upon the welfare of industrial workers. Under the pretense of social and economic safety, there is introduced an account of Sir Wm. Lever's industrial community of Port Sunlight, Mr. Edward Cadbury's village community of Bournville (both in England) and the several Krupp colonies in Germany. The chapter on After Hours branches out frankly upon the subject of social betterment among industrial workers with no attempt to regard it as another branch of safety. Finally in the closing chapter is presented a most interesting account of the organization and activities of the American Museum of Safety.

The chief criticism of the book is that of inferior classification and arrangement of its contents. This is particularly in evidence in Parts I and II which seem to reveal a hasty preparation. In the chapters dealing with mechanical contrivances for preventing accidents, there is room for large improvement in the way of rearrangement, elimination of repetition and the introduction of helpful subheadings. The book as a whole, while of much interest and value, leaves the reader with a well defined sense of disappointment—a feeling that as the acknowledged leader of the movement for industrial safety in this country, preparing the first comprehensive work on the subject in the English language, Mr. Tolman has scarcely made the most of his opportunity.

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The Aetna company's book on "Safeguards" is one that could well have been taken by Mr. Tolman as a model for that part of his book which has to do with mechanical contrivances for the prevention of accidents. The safeguards are classified according to the mechanical nature of the apparatus with which they are to be used under the following headings; gears; belts and pulleys; flywheels and driving chains; set screws, sprocket wheels and chains; rolls and knives; punch presses, grindstones and emery wheels; stairways, platforms and runways; woodworking machinery; elevators. Special chapters are devoted to the Electrical Hazard and to Contracting. Each device is both concisely described and illustrated by a clear half-tone or line-cut showing sufficiently well its construction and purpose.

The book opens with a discussion of the general causes and contributory conditions which give rise to accidents. These causes are classified as follows: ignorance, carelessness, unsuitable clothing, insufficient lighting, defects of machinery and structures, insufficient room, uncleanly conditions, lack of good air, absence of safeguards. This discussion is followed by a number of pages of general suggestions on safeguarding, and then comes the classified catalogue of mechanical safeguards. The final chapters present specimen rules and regulations, warning notices, etc., and a general discussion of workmen's compensation laws and of industrial insurance. The text is characteriezd throughout by the generous use of subheadings in boldfaced type, and these together with the systematic arrangement of the contents make it a book which is both easy to read and convenient for reference.

THE OHIO VALLEY FLOOD OF MARCH-APRIL, 1913 (Including Comparisons with Some Earlier Floods)—By A. H. Horton and H. J. Jackson. Water Supply Paper 334. Washington, D. C.: United States Geological Survey. Paper; 6x9 in.; pp. 96; illustrated.

The Geological Survey has compiled the very scanty available data concerning floods in the Central States streams, "for the convenience of the public and particularly of the

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engineering profession, and to emphasize the necessity of immediately starting, on a comprehensive scale, the collection of stream-flow data in the Ohio Valley." The pamphlet includes chiefly: Rainfall records for the flood of last March, flood-flow figures (for the Ohio River only, no figures or estimates for tributaries involved in the 1913 floods), similar figures for some earlier floods, gage heights for all the known high floods of the Ohio, a statement of the origin and occurrence of the March flood, an estimate of the damage done by the flood, some flood-wave profiles (only Ohio River for the 1913 flood), and photographs from the flood districts. The estimate of money damage (Ohio, Indiana and Illinois) is $180,000,000; but this includes the round figure of $100,000,000 for Dayton, and also it is not clear whether such items as railway loss are included, so that the estimate does not carry much weight.

THE RAILWAY LIBRARY, 1912—A Collection of Noteworthy Addresses and Papers, Mostly Delivered or Published During the Year Named. Compiled and Edited by Slason Thompson, Director. Chicago, Ill.: Bureau of Railway News and Statistics, Railway Exchange Building. Cloth; 6x9 in.; pp. 470. 50c.

This is the fourth annual compilation by Mr. Thomson of some of the important articles and addresses appearing during the year bearing on current events in the railway world. Among the twenty-five articles in the volume are two by Charles Colson, of France, the eminent economist and engineer, two by members of the Interstate Commerce Commission and several by presidents of railway companies. The selections of articles cover quite a wide range, and many of them are so valuable that they well deserve to be bound in permanent form instead of lost, as would ordinarily be the case, in the vast mass of current newspapers and periodicals.

## NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ABSTRACT OF CURRENT DECISIONS ON MINES AND MINING, October, 1912, to March, 1913—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 82.

AGRICULTURAL DRAFTING—By Charles B. Howe. [Wiley Technical Series for Vocational and Industrial Schools.] New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 11x8 in.; pp. vii + 63; 43 text illustrations and 26 plates. $1.25, net.

AMERICAN ROAD BUILDERS' ASSOCIATION—Proceedings of Dec. 3, 1912, together with Reports of the Executive Committee, Secretary and Treasurer of Feb. 7, 1913. New York: The Association, 150 Nassau St. Paper; 6x9 in.; pp.; 315; illustrated. $2.

AMERICAN SOCIETY FOR TESTING MATERIALS—Index to Proceedings, Volumes I-XII (1898-1912). Philadelphia, Penn.: Prof. Edgar Marburg, Secretary, University of Pennsylvania. Cloth or half-morocco, 6x9 in.; pp. 158. Cloth, $1.50; half-morocco, $2.

AUSTRALIAN COMMONWEALTH OFFICIAL STATISTICS—Population and Vital Statistics, Bulletin 30, and Commonwealth Demography, 1912, and Previous Years. Melbourne, Australia: Commonwealth Bureau of Census and Statistics. Paper; 8x12 in.; pp. 247.

BRITISH COLUMBIA DEPARTMENT OF LANDS—Report of Water Rights Branch for 1912. Victoria, B. C.: J. F. Armstrong, Acting Comptroller of Water Rights. Paper; 7x10 in.; pp. 120; illustrated.

BULLETIN OF THE ALUMNI COUNCIL OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—Report of the Executive Committee on a Course in Business Engineering [Reprinted from "The Technology Review," Boston, July, 1913.] Boston, Mass.: Walter Humphreys, Secretary, Alumni Association, 491 Boylston St. Paper; 7x10 in.; pp. 20.

CANADA DEPARTMENT OF MINES—Annual Report on the Mineral Production of Canada During the Calendar Year 1911. Ottawa, Ont.: John McLeish, Chief of the Division of Mineral Resources and Statistics. Paper; 6x10 in.; pp. 316.

CANADA MINISTERE DES CHEMINS DE FER ET CANAUX—Report Annuel 1912. Ottawa, Can. Paper; 7x10 in.; pp. 335; illustrated; accompanying maps in envelope.

CANADIAN CANAL STATISTICS FOR SEASON OF NAVIGATION, 1912. Ottawa: Department of Railways and Canals. Paper; 7x10 in.; pp. 111.

CARBONIC ACID GAS CYLINDERS IN SERVICE—Report on Recent Investigations, Made to The Compressed Gas Manufacturers' Association by Messrs. H. L. Scuricke and J. C. Minor, Jr. New York City: John J. O'Rorke, Secretary, 25 Madison Ave. Paper; 6x9 in.; pp. 52; 28 text illustrations.

COLORADO SCIENTIFIC SOCIETY PROCEEDINGS—Vol. X, pp. 265-278, Investigation of Roof-Shale Dust with Reference to Its Adaptability as a Deterent in Coal-Dust Explosions—By Richard C. Hills. Vol. X, pp. 279-414, Report of the Committee on Uniform Mine Accident Laws. Denver, Colo.: The Society. Paper; 6x9 in.; illustrated. Two pamphlets.

CONCILIATION AND ARBITRATION IN THE BUILDING TRADES OF GREATER NEW YORK—Washington, D. C.: Bureau of Labor Statistics. Paper; 6x9 in.; pp. 95.

CONSERVATION OF NATIONAL RESOURCES—Report of the Conservation Committee of the American Unitarian Association, 25 Beacon St., Boston, Mass. [Social Service Series.] Bulletin 28. Paper; 5x7 in.; pp. 25. For free distribution.

CYANIDE PRACTICE 1910 TO 1913—Edited by M. W. von Bernwitz. San Francisco, Calif.: "Mining and Scientific Press." London: "The Mining Magazine." Cloth; 6x9 in.; pp. 732; numerous illustrations. $3, net.

DESIGN OF PLATE GIRDERS—By Lewis E. Moore, Assoc. M. Am. Soc. C. E.; Associate Professor of Structural Engineering, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 285; 82 text illustrations. $3, net.

DETERMINATION OF SULPHUR IN ILLUMINATING GAS—By R. S. McBride, Assistant Chemist, and E. R. Weaver, Laboratory Assistant. Washington, D. C.: Bureau of Standards. Technologic Paper 20. Paper; 7x10 in.; pp. 46; illustrated.

ECONOMIC MINERALS AND MINING INDUSTRIES OF CANADA—Ottawa: Department of Mines. Paper; 6x9 in.; pp. 77; illustrated.

ECONOMICS OF BUSINESS—By Norris A. Brisco, author of "The Economic Policy of Robert Walpole;" Departmental Editor for Canada "Book of Knowledge"; Department of Political Science, College of the City of New York. New York: The Macmillan Co. Cloth; 5x8 in.; pp. xiv + 390. $1.50.

ENGINEERING AS A PROFESSION; Scope, Training and Opportunities for Advancement—By A. P. M. Fleming, M. I. E. E., and R. W. Bailey, Principal of the Technical Institute, Crewe. London, England: John Long, Ltd., Norris St., Haymarket. Cloth; 5x8 in.; pp. xii + 288. 2/6, net.

ERNEST KEMPTON ADAMS FUND FOR PHYSICAL RESEARCH—Publication No. 4, Graphical Methods [A Course of Lectures Delivered in Columbia University, New York, October, 1909, to January, 1910]—By C. Runge, Professor of Applied Mathematics, University of Göttingen. Publication No. 6, Researches in Physical Optics, with Especial Reference to the Radiation of Electrons; Part 1—By R. W. Wood, Professor of Experimental Physics, Johns Hopkins University. New York: Columbia University. Two pamphlets. Paper; 10x13 in.; pp. 148 and 134, respectively; illustrated.

FARM GAS ENGINES—By C. F. Hirshfeld, Professor of Power Engineering, and T. C. Ulbricht, Instructor, Department of Power Engineering, Sibley College, Cornell University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. vii + 239; 188 text illustrations. $1.50 (6/6) net.

FLOOD CONTROL ON THE LOWER MISSISSIPPI RIVER: An Address Delivered before the Alumni of the University of the South, at Sewanee, Tenn., by Albert S. Caldwell, Memphis, Tenn.: Mississippi River Levee Association. Paper; 6x9 in.; pp. 15.

FORMULAE AND TABLES FOR THE CALCULATION OF ALTERNATING CURRENT PROBLEMS—By Louis Cohen. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. x + 282; 69 text figures. $3, net.

HYDRAULIC TURBINES; With a Chapter on Centrifugal Pumps—By R. L. Daugherty, Assistant Professor in Sibley College, Cornell University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 151; 96 text figures. $2, net.

INDIANA SANITARY & WATER SUPPLY ASSOCIATION—Proceedings of Feb. 25-26, 1913. Indianapolis, Ind.: Dr. W. F. King, Secretary. Paper; 6x9 in.; pp. 187.

INTERNATIONAL RAILWAY FUEL ASSOCIATION—Proceedings of Fifth Annual Convention. Chicago, Ill.: C. G. Hall, Secretary, 922 McCormack Bldg. Paper; 6x9 in.; pp. 328.

INVESTIGATIONS OF DETONATORS AND ELECTRIC DETONATORS—By Clarence Hall and Spencer P. Howell. Bulletin 59. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 73; illustrated.

JIGS AND FIXTURES; A Reference Book Showing Many Types of Jigs and Fixtures in Actual Use, and Suggestions for Various Cases—By Fred H. Colvin, M. Am. Soc. M. E., Associate Editor, "American Machinist," and Lucian L. Haas, M. Am. Soc. M. E., Tool Designer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. vii + 168; 391 text illustrations. $2, net.

JOURNAL OF THE IRON AND STEEL INSTITUTE—Edited by George C. Lloyd, Secretary. Vol. LXXXVII. No. 1, 1913. London, England: The Institute, 28 Victoria St., S. W., and E. & F. N. Spon. New York City: Spon & Chamberlain. Cloth; 6x9 in.; pp. 774; illustrated.

LA IRRIGACION DEL VALLE DE ICA—By C. W. Sutton, M. Am. Soc. C. E., Chief Engineer, Peruvian Irrigation Service. Lima, Peru: Cuerpo de Ingenieros de Minas; Jose J. Bravo, Director. Cloth; 7x10 in.; pp. 197; illustrated.

LAYING OUT FOR BOILER MAKERS AND SHEET-METAL WORKERS—A Practical Treatise on the Layout of Rollers, Stacks, Tanks, Pipes, Elbows and Miscellaneous Sheet Metal Work. Second edition. New York: Aldrich Publishing Co. Cloth; 10x13 in.; pp. 302; numerous text illustrations. $5.

LEHRBUCH DES MASCHINENBAUES—Herausgegeben von Karl Esselborn. Zweiter Band: Dynamomaschinen und Elektromotoren; Hebemaschinen; Baumaschinen; Wasserkraftanlagen; Bearbeitungsmaschinen. Leipzig and Berlin: Wilhelm Engelmann. Paper; 8x11 in.; pp. xvi + 671; 1028 illustrations. 30 Marks.

LEITFADEN DER FLUGTECHNIK; Für Ingenieure, Techniker und Studierende—By Siegmund Huppert, Direktor des Kyffhauser-Technikums, Frankenhausen a. Kyffh. Berlin: Julius Springer. Cloth; 6x9 in.; pp. ix + 368; 235 illustrations. 12 Marks.

LETTERS AND RECOLLECTIONS OF ALEXANDER AGASSIZ, With a Sketch of His Life and Work—Edited by G. R. Agassiz. Boston and New York: Houghton, Mifflin Co. Cloth; 6x9 in.; pp. 454; numerous plates and other illustrations. $3.50, net.

THE LIFE WORK OF EDWARD A. MOSELEY IN THE SERVICE OF HUMANITY—By James Morgan. New York City: The Macmillan Co. Cloth; 6x9 in.; pp. ix + 378; 7 plates. $2, net

MACHINES ROTATIVES A TRES GRANDES VITESSES (TURBINES, COMPRESSEURS ET DYNAMOS)—Par Maurice Leblanc. [Extrait des Mémoires de la Société des Ingénieurs Civils de France, Bulletin de février 1913.] Paris: La Société, 19 Rue Blanche. Paper; 6x9 in.; pp. 117; illustrated.

MAINE WATER STORAGE COMMISSION—Third Annual Report, 1912. Augusta, Me.: Cyrus C. Babb, Chief Engineer. Cloth; 6x9 in.; pp. 261; illustrated.

MASSACHUSETTS BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS (Boston, Mass.)—Twenty-Eighth Annual Report for 1912, Including Tables from Annual Returns for Year Ending June 30, 1912. Paper; 6x9 in.; pp. 717.

MECHANICS AND HEAT: An Elementary Course of Applied Physics—By J. Duncan, M. I. Mech. E., Head of Department of Civil and Mechanical Engineering, Municipal Technical Institute, West Ham; author of "Applied Mechanics for Beginners" and "Steam and Other Engines." New York: The Macmillan Co., London: Macmillan and Co., Ltd. Cloth; 5x8 in.; pp. xiii + 381; 314 text illustrations. $1, net.

METALLOGRAPHIC TESTING—Circular No. 42. Washington, D. C.: Bureau of Standards. Paper; 7x10 in.; pp. 16.

MINING AND TREATMENT OF FELDSPAR AND KAOLIN in the Southern Appalachian Region—By A. S. Watts. Bulletin 53. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 170; illustrated.

MINISTER OF MINES OF BRITISH COLUMBIA—Annual Report for 1912. Victoria, B. C.: Bureau of Mines. Paper; 7x10 in.; pp. 349; illustrated.

NATIONAL ASSOCIATION OF PORT AUTHORITIES OF THE UNITED STATES—Proceedings of First Meeting, New York City, Dec. 9, 1912; with Constitution. New York City: W. J. Barney, Assistant Secretary, 29 Broadway. Paper; 6x9 in.; pp. 75.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS (Trenton, N. J.)—Report for 1912. Pp. 504. Abstracts of Report made by Public Utilities to the Board and published as part of the Report for 1912. Pp. 289. Paper; 6x9 in.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS—Report of the Chief Commissioner for the Year Ended June 30, 1913. Sydney, N. S. W., Australia. Paper; 8x13 in.; pp. 66; 2 folding maps.

NEW YORK PUBLIC LIBRARY—List of Works Relating to the Development and Manufacture of Typewriting Machines. Paper; 7x10 in.; pp. 18.

NEW YORK STATE PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT—Report for Year Ended Dec. 31, 1911: Vol. III, Statistics of Gas and Electric Companies. New York City: The Commission, 154 Nassau St. Cloth; 6x9 in.; pp. 526.

NEW YORK STATE PUBLIC SERVICE COMMISSION, SECOND DISTRICT (Albany, N. Y.)—Sixth Annual Report, 1912. Cloth. Vol. I, 6x9 in.; pp. 1020. Vol. II, 9x12 in.; pp. 412.

OHIO STATE HIGHWAY DEPARTMENT—Eighth Annual Report for Year Ended Nov. 15, 1912. Columbus, O.: James R. Marker, State Highway Commissioner. Paper; 6x9 in.; pp. 276; illustrated.

PERMANENT INTERNATIONAL ASSOCIATION OF NAVIGATION CONGRESSES—Report of the XIIth Congress, 1912, Brussels, Belgium: Executive Committee, Office of General Secretary, 38, Rue de Louvain. Cloth; 6x9 in.; pp.xvi + 674; illustrated.

THE POLYTECHNIC ENGINEER—Vol. XIII (1913). Published annually by the Students of the Polytechnic Institute of Brooklyn, N. Y. Cloth; 6x9 in.; pp. 138; illustrated.

POWER PLANT TESTING; A Manual of Testing Engines, Turbines, Boilers, Pumps, Refrigerating Machinery, Fans, Fuels, Lubricants, Materials of Construction, etc.—By James Ambrose Moyer, M. Am. Soc. M. E., Professor of Mechanical Engineering, Pennsylvania State College and in Charge of the Engineering Experiment Station. Second edition, rewritten, enlarged and entirely reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 486; 393 text figures. $4, net.

PRACTICAL PHYSICS FOR SECONDARY SCHOOLS; Fundamental Principles and Applications to Daily Life—By N. Henry Black, Science Master, Roxbury Latin School, Boston, Mass., and Harvey N. Davis, Assistant Professor of Physics, Harvard University. New York: The Macmillan Co. Cloth; 5x8 in.; pp. ix + 487; 465 text illustrations and several plates. $1.25.

PRELIMINARY REPORT OF THE OHIO FLOOD [illegible], with Memorandum from the Chief of Engineers, U. S. A. [Report by Lieut.-Col. Francis R. Shunk, for the Board, dated May 26, 1913; Memorandum by Gen. Wm. T. Rossell, dated Sept. 30, 1913.] Washington, D. C.: House Doc. No. 246. Paper; 6x9 in.; pp. 8.

An abstract of this report was published on pp. 72[illegible] and 726 of our issue of Oct. 9, 1913.

PREVENTION AND CONTROL OF DISEASE—By F[illegible]ds Ramaley, Professor of Biology, and Clay E. Gifford, Instructor in Surgery; University of Colorado. Boulder, Colo.: The University Store. New York: G. E. Stechert & Co. Cloth; 6x9 in.; pp. 386; illustrated. $3, postpaid.

THE PREVENTION OF WASTE OF OIL AND GAS FROM FLOWING WELLS IN CALIFORNIA, With a Discussion of Special Methods Used by J. A. Pollard—By Ralph Arnold and V. R. Garfias. Washington, D. C.: Bureau of Mines. Technical Paper 42. Paper; 6x9 in.; pp. 15; illustrated.

PRINCIPLES OF INDUSTRIAL ORGANIZATION—By Dexter S. Kimball, M. Am. Soc. M. E., Professor of Machine Design and Construction; Sibley College, Cornell University; author, with John H. Barr, of "Elements of Machine Design," "Industrial Education," etc. Cloth; 6x9 in.; pp. xiv + 272; 19 plates and text figures. $2.50, net.

REPRINTS FROM BULLETIN OF THE BUREAU OF STANDARDS, Vol. 9—No. 200: New Calorimetric Resistance Thermometers. By H. C. Dickinson, Associate Physicist, and E. F. Mueller, Assistant Physicist. No. 202: Note on Cold-Junction Corrections for Thermocouples. By Paul D. Foote, Laboratory Assistant. Paper; 7x10 in.; pp. 483-492 and 1-13; illustrated.

ROBERT FULTON, ENGINEER AND ARTIST; HIS LIFE AND WORKS—By H. W. Dickinson, Assoc. M. I. Mech. E., Assistant Keeper, The Science Museum, South Kensington. New York: John Lane Co. London: John Lane, The Bodley Head. Cloth; 6x9 in.; pp. xiv + 333; numerous plates. $3, net.

SANITARY OFFICERS OF THE STATE OF NEW YORK—Proceedings of Dec. 4-6, 1912. Albany, N. Y.: New York State Department of Health. Paper; 6x9 in.; pp. 272.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION—Proceedings of June 26-29, 1912. Part II, Vol. XX. Ithaca, N. Y.: Prof. H. H. Norris, Secretary, Cornell University. Cloth; 6x9 in.; pp. 508; illustrated. $1.25.

SOUTH AFRICA MINES DEPARTMENT—Annual Report for 1912. Part I by Secretary for Mines and Commissioner of Mines for Natal. Part II by Government Mining Engineer. Capetown, S. A.: The Department. Paper; 8x13 in.; pp. 182; 33 tables. 10/6.

STANDARD REGULATIONS FOR MANUFACTURED GAS AND GAS SERVICE—Second edition; superceding Circular No. 32, entitled "State and Municipal Regulations for the Quality, Distribution and Testing of Illuminating Gas." Washington, D. C.: Bureau of Standards, Paper; 7x10 in.; pp. 170.

STANDARD SPECIFICATIONS FOR EXTERIOR PLASTERING (STUCCO)—Associated Metal Lath Manufacturers, 812 Wick Bldg., Youngstown, Ohio. Paper; 6x9 in.; pp. 11; illustrated.

THE STATUS AND PROFESSIONAL RELATIONS OF THE ENGINEER—A Discussion held at meetings of the American Institute of Consulting Engineers, Dec. 18, 1912, and Mar. 11, 1913. New York City: Eugene W. Stern, Secretary, 101 Park Ave. Paper; 6x9 in.; pp. 92.

SUR LE TRANSPORT ELECTRIQUE DE L'ENERGIE PAR COURANTS ALTERNATIFS A TRES HAUTE TENSION—Par M. Maurice Leblanc. [Supplement au Bulletin de la Société Internationale des Electriciens.] Paris: Gauthier-Villars, Quai des Grands-Augustus, 55. Paper; 7x10 in.; pp. 71; illustrated.

TECHNICAL GAS AND FUEL ANALYSIS—By Alfred H. White, Professor of Chemical Engineering, University of Michigan. [International Chemical Series.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x8 in.; pp. x + 276; 47 text figures. $2, net.

THIRTEENTH CENSUS OF THE UNITED STATES, 1910, Vol. II, Population. Washington, D. C.: Bureau of the Census. Cloth; 9x12 in.; pp. 1160; illustrated.

TRANSFORMER PRACTICE; Manufacture, Assembling, Connections, Operation and Testing—By William T. Taylor, Fellow, Am. Inst. E. E. Second edition, entirely rewritten, enlarged and reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. vii + 278; 191 text figures. $2.50, net.

TRANSPORTATION RATES TO THE WEST COAST OF SOUTH AMERICA—By F. J. Sheridan, Commercial Agent, Department of Commerce. [Special Agent Series, No. 72.] Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper: 6x9 in.; pp. 99.

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Engineering News

VOLUME 70 OCTOBER 23, 1913 NUMBER 17

# Novel Features in Flume and Penstock Design: The Puntledge River Power Development, Vancouver, B. C.*

The firm Canadian Collieries (Dunsmuir) Ltd., of Victoria, B. C., owns and operates a group of coal mines in the vicinity of Union Bay, Vancouver Island, and the power for the operation of these coal mines heretofore has been generated by separate steam plants at the various mines. Some three years ago the problem of renovating and enlarging some of these plants presented itself for solution in the near future. General estimates were made of the capital cost of such improvements and also of a central steam-electric power station with a distribution system to the respective mines. At the same time surveys were made to determine the cost of available hydro-electric power for the same purpose. Comparative estimates showed that with coal (showing a calorific value of 14,000 B.t.u. per lb.) at $2.50 per ton delivered at the power station, the cost of installation and operation was greatly in favor of the hydro-electric development, and this method was accordingly adopted.

The available power was that of the Puntledge River, which is the outlet of a lake of the same name about eight miles from Comox Harbor, with an area of approximately 9 sq.mi. and a low-water level 420 ft. above tidewater. Puntledge River has an observed flow ranging between 330 and 3500 sec.-ft. (cu.ft. per sec.) and, by building an impounding dam at the outlet of the lake to raise the water 23 ft. and cutting the bottom of the outlet to a depth of 5 ft. below low water, an available storage capacity of 23 ft. of depth is obtained, equivalent to about 132,000 acre-feet. Considering with this the regimen of the river, as recorded during the short period of observed flow, it is estimated that a constant flow of at least 800 sec.-ft. can be maintained for the development of power. The rated capacity of the ultimate plant will be about 19,000 hp. at the turbine shaft; this being in excess of the requirements for the owner's own industries, the spare power is intended to supply other industries either established or contemplated in the district.

From the impounding dam, the water flows in the natural bed of the river to an intake reservoir formed in the bed of the river by a diversion dam about 2½ miles below the lake. This dam consists of a spillway and an intake with head gates, which divert the water for power development into a canal and flume line 3400 ft. long, the latter discharging into a forebay forming the intake of the penstock system. From the forebay the water is carried in a wood-stave pipe, 8 ft. in diameter and 5380 ft. long to a Y structure with two outlets for pipes 6 ft. in diameter fitted with 6-ft. gate valves. The next section of the present system consists of one line of 6-ft. stave pipe which is to be duplicated at some future time as only one-half of the ultimate penstock system is now built from this Y to the power house. This 6-ft. pipe is 4500 ft. long and it leads to a junction structure having inlets for two 6-ft. pipes and outlets for four 50-in. pipes, the interior of this structure forming a common chamber. Gate valves are installed here at both the inlets and the outlets. The penstocks from this point down are 50 in. in diameter; there are to be four in the completed system but only two are constructed for present purposes. These two 50-in. pipes are built of wood staves and steel bands for a distance of 3170 ft.; for the remaining distance of 660 ft. to the power house the pipes are of steel. Only one-half of the projected generating machinery has been installed, there being two reaction-type turbines with their horizontal shafts direct connected to alternating-current generators of revolving-field 25-cycle three-phase type.

As seen from the foregoing outline, the plant differs but little in general outline from the usual scheme of such hydro-electric development. But looking at further details, there are some features of unusual design and these are noted in what follows.

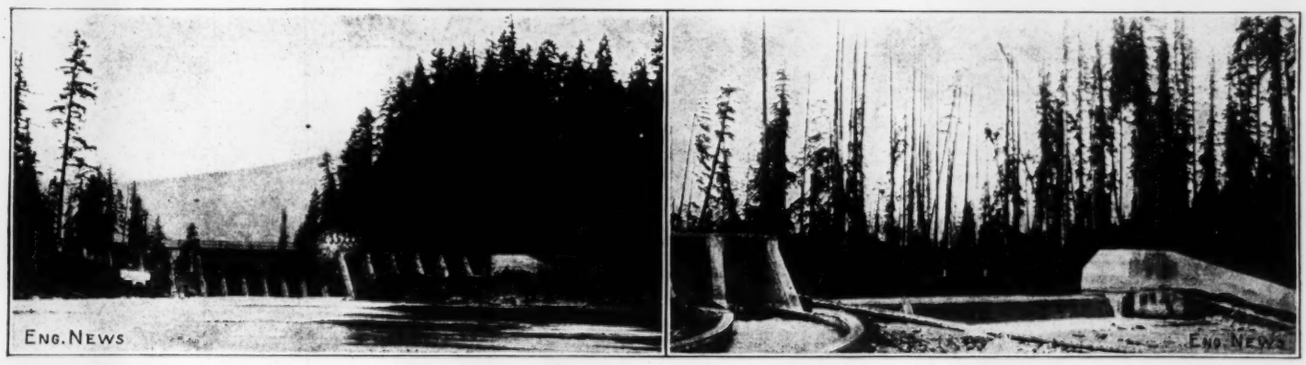


FIG. 1. IMPOUNDING AND DIVERSION DAMS, PUNTLEDGE DEVELOPMENT

*From notes, drawings and photographs furnished by H. K. Owens and A. V. Bouillon, Engineers, Empire Building, Seattle, Wash

### Headworks

Impounding Dam—The impounding dam is approximately 300 ft. long with a crest elevation of 445 ft. and a gate-sill elevation of 416 ft. The gateways, together with spillways aggregating 100 ft. length, give a flood-

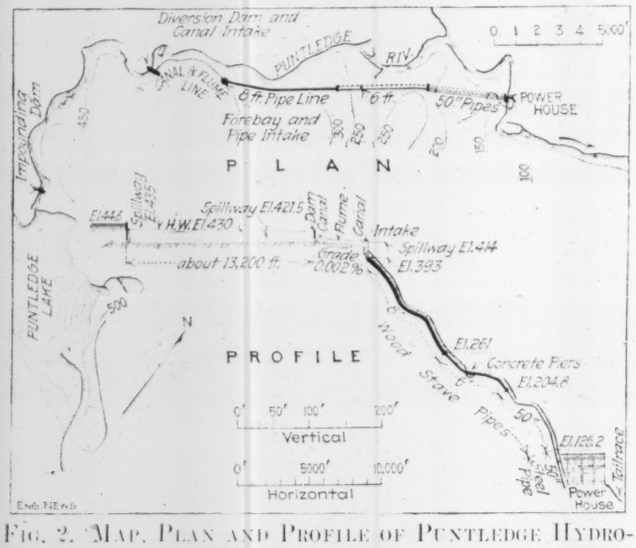


Fig. 2. Map, Plan and Profile of Puntledge Hydro-Electric Project

discharge capacity of 10,000 sec.-ft., which is in excess of the highest recorded outflow from the watershed. In general type this structure is a buttressed wall of concrete partly reinforced, the design of which may be seen from Fig. 1. A special feature is a log sluice (required by Government regulations) which was secured by omitting the wall in one dam panel and substituting therefor suitable stop logs readily removable one at a time to obtain the necessary depth for the passage of logs at any stage of water level. The storage of water and its flow over the spillways are controlled by wooden needles which close the spillway wickets and are so made and installed as to be readily removed for relief in time of flood. These needles are of 3x4-in. lumber 12 ft. long, dressed to $2\frac{5}{8}$x$3\frac{5}{8}$ in. and fitted with forged iron ends for protection and handling. There are six gateways, each 5x6 ft. controlled by steel butterfly gates with vertical axes. The gates are stepped in bearings set in the sill; the spindle extends to the gallery at the top of dam and through a cast-iron pedestal frame which carries the weight of the gate and spindle and holds a worm-operating gear fitted with double hand cranks. The gates fit loosely into the gateways, it being not intended to obtain water-tightness; their vertical position is adjustable overhead at the thrust bearing.

The dam is built on solid rock; the concrete is composed of ordinary gravel aggregates in a 1:2½:5 mix, with approximately 10% of hydrated lime added to the cement as a neutral filler to obtain water-tightness. To insure against uplift of the structure from pressure in horizontal seams which might exist in the underlying rock a number of weep holes were drilled in the rock to a depth considered sufficient and were fitted with open pipes leading up and out to the downstream face of the dam.

Diversion Dam—This dam is also built of concrete and partly reinforced at the intake end; the spillway is 100 ft. long. The Government regulations required a fish ladder at this dam and this was built in one of the concrete abutments (Fig. 1) so as to be protected from damage in time of flood. There are two gateways in this dam each 6 ft. by 7 ft. wide; the gates are of steel plates riveted on frames of steel channels and are fitted with rollers to reduce friction in operation. Water-tightness is obtained by flexible diaphragm strips which bear upon the face of the gateway along the sides and top and by a cushion on the bottom which seats on a steel channel sill laid inverted in the concrete floor. The gateways are protected by sectional steel screens designed for convenient handling and upkeep. The lifting gears for the gates are of the rising-stem screw type, the stems being 2½ in. in diameter with bevel-geared operating stands and hand cranks located on an overhead working platform.

Canal and Flume—This division of the work has alternating sections of canal and flume in which there are many sharp curves necessitated by the broken nature of the ground. The canal sections occur in solid rock, sand, gravel and clay—all being lined with concrete except some parts cut through impervious clay. The intermittent sections of canal are connected by a wooden flume built of staves laid on steel suspension rods carried by and between side girders laid on bents placed 16 ft. center to center.

Fig. 3. Semicircular Flume on Bents and Piles

The flume is approximately semi-circular in shape, 12 ft. wide and 7 ft. deep. The staves are of 3x6-in. lumber dressed to $2\frac{9}{16}$x$5\frac{7}{16}$ in.; the suspension rods are ¾ in. in diameter, are spaced 24 in. on centers, and are ad-

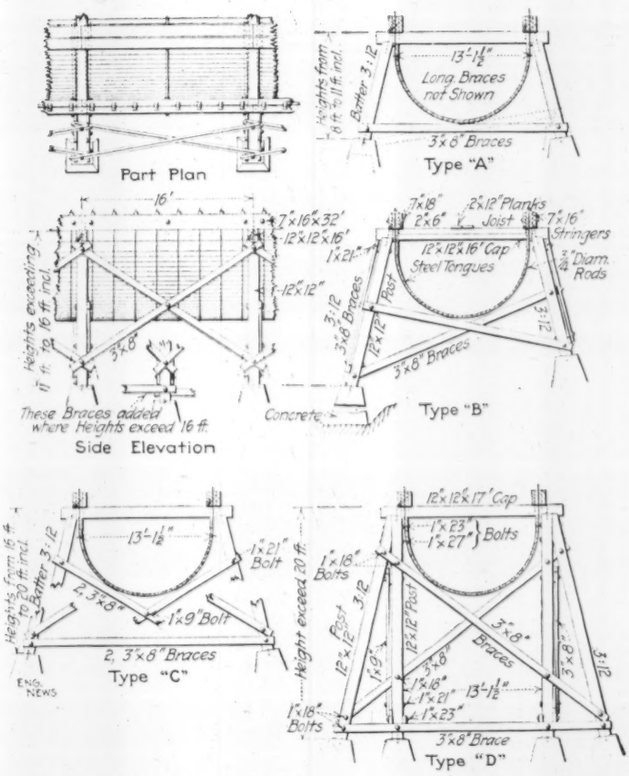


FIG. 4. DESIGNS OF BENTS FOR WOOD-STAVE FLUME

justable over each girder by screw ends with nuts over specially designed washers. The girders are built up of double fir timbers, 8x16 in., with space between, fixed by separators, for passing the suspension rods through. The flume bents are built on concrete piers except across a swamp where the girders are carried directly on piles driven to solid bottom. This design was found to be economical and well adapted to rapid erection.

The canal and flume line terminates with a short section of reinforced-concrete canal, the shape of which is gradually changed to secure smooth entrance into the forebay structure. Before reaching the forebay, one side of the canal is formed into a spillway of capacity sufficient to carry away the entire flow to this point (Fig. 5). A rotary balanced steel gate, "Taintor" type, is installed at the canal entrance to the forebay to regulate or to shut off the supply from the canal and flume line. (This is only the second plant in America recorded as having this style of headgates, the first being the Au Sable River development in Michigan, see ENGINEERING NEWS, May 16, 1912.) This gate is 12 ft. wide and approximately 10 ft. high; in structure it consists of two main arms made of steel channels gusseted to the steel-channel gate frame and covered by steel plates. The gate is balanced by a cast-iron beam of heavy section fitted as a spreader at the end of the supporting arms which extend back from the trunnion bearings within the

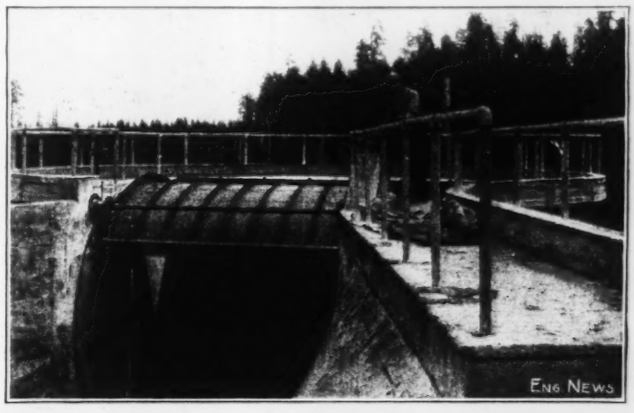


FIG. 6. TAINTOR HEAD GATES AT THE PUNTLEDGE PLANT

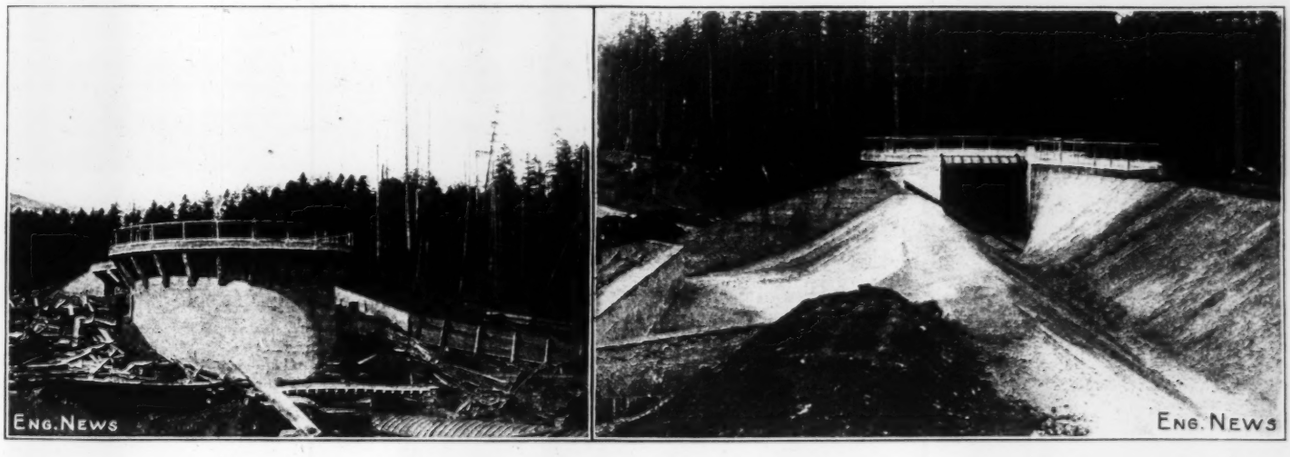


FIG. 5. REINFORCED-CONCRETE FOREBAY AND APPROACH CANAL

Wood was adopted for flume and supporting structures because of the general adaptability of the material to the local requirements. The design has been so made that any part of the support can be renewed without interrupting the operation of the plant. The flume itself except for staves near the flow line is under practically the same conditions as submerged wood and therefore of indefinite life; no trouble is expected in the maintenance of the flume proper since a large part of it can be replaced without shutting down entirely.

forebay for this purpose. The gate is operated by hand gear high up at one side of the canal and working through a chain and pinion shaft engaging circular racks secured to the plated face of the gate. Water-tightness of this gate is obtained by flexible diaphragm strips which are fastened to the side edges of the gate and slide in grooves formed in the side walls of the canal to match the shape of the gate, the seats for the strips being brass bars laid in the grooves and secured in the concrete. The bottom of the gate is fitted with a soft cushion which

seats on the concrete floor of the canal and, while it was not intended to have this gate absolutely water-tight, it is found to be practically tight in actual service. It works well in other particulars.

FOREBAY—This name generally implies a reservoir of some considerable capacity intended to provide for constancy of supply to the penstock system but the corresponding structure in this case was designed as a suitable form of intake for the penstock rather than as a reservoir, since the canal and flume line are depended upon to provide the requisite forebay capacity. Essentially, the forebay structure is a vertical reinforced-concrete cylinder with the canal entrance on one side and the pipe intake opposite. The basin formed by this structure is divided into two sections, which are separated by a weir wall and screens. That section into which the canal discharges forms a sedimentation basin with its floor sloping to a sluice-gate blowoff; the other section forms the intake of the penstock pipe and is completely inclosed.

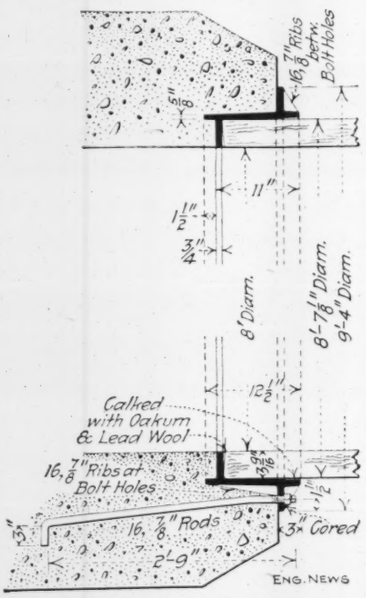


FIG. 7. FOREBAY CONNECTION WITH WOOD-STAVE PIPE

The concrete in this structure is composed of the same aggregates as already specified for the impounding dam, including the same proportion (10%) of hydrated lime and it is found to be water-tight in service. The outlet connection of the 8-ft. pipe is funnel shaped, 12 ft. in diameter at the inner end and tapering to 8 ft. in diameter in 7 ft. length. For connection with the wood-stave pipe, a cast-iron ring was laid and anchored in the concrete at the mouth of the outlet, the cross-section of which (Fig. 7) forms a rabbet for the pipe staves with tapering clearances which provide calking spaces all around the pipe outside and at the end of the staves inside. The calking materials used are oakum and lead wool and the joint thus obtained is very satisfactory. Similar construction was employed for all transitions from wood-stave pipe.

## PENSTOCK

STAVE PIPES AND SHOES—The staves in the 8-ft. pipe are made of 4x6-in. lumber, finished to a thickness of $3\frac{9}{16}$ in. and an outside width of $5\frac{9}{16}$ in., there being 58 staves around the circumference. The staves for the 6-ft. and 50-in. pipes are made of 3x6-in. lumber, dressed down to $2\frac{9}{16}$- and 2½-in. thickness, respectively, and maximum widths of $5\frac{5}{8}$ and $5\frac{9}{16}$ in.; 43 staves form the full circle of the larger pipe and 31 staves that of the latter. These staves are all made of clear Douglas fir. The stave ends are grooved for a steel tongue ⅛-in. thick and 2 in. wide to make the butt joints tight. The bands for all pipes are uniformly 1 in. in diameter; the maximum spacing is 12 in., center to center, but this occurs at the upper end of the 8-ft. pipe only; the minimum spacing is 2 in. center to center which is as close as bands and shoes of the size adopted can be laid. Where the pressure required closer spacing the size of the pipe was changed and this determined the lengths of pipes of the several sizes noted in the brief description first given of the penstock system.

The bands are made in two sections, one having threaded and the other button-head ends. The threads are rolled on. Each band has two coupling shoes of malleable iron. A great deal of study was given to the design of the shoes or couplings for pipe bands; a number of standard shoes offered by manufacturers were examined and some were tested with a view to their adoption. But none of the ready-made ones offered were found satisfactory, it being apparent that the larger sizes offered were mere expansions of original designs for comparatively small sizes without adequate increase in dimensions to balance the increases in sizes of either pipes or bands. Therefore, the shoes used on the various pipes of this system were designed especially to meet the actual requirements. In testing some of the ready-made shoes offered, it was found that the threaded end of the band with nut and washer would easily slip off when under stress even before any noticeable deformation of the shoe had taken place and some of them had such a narrow margin of safety in this particular that they would not be safe to use on pipes of any considerable size. Careful attention was therefore given to this feature. The designs for the larger pipes vary somewhat from that adopted for the smallest size. On the shoes for the 50-in. pipe an inward slope as well as a dish is provided in the face of the lugs, securely to hold the band end; this was considered safe for pipe of this size and band curvature, but for the pipes of the larger sizes, the curvature of the

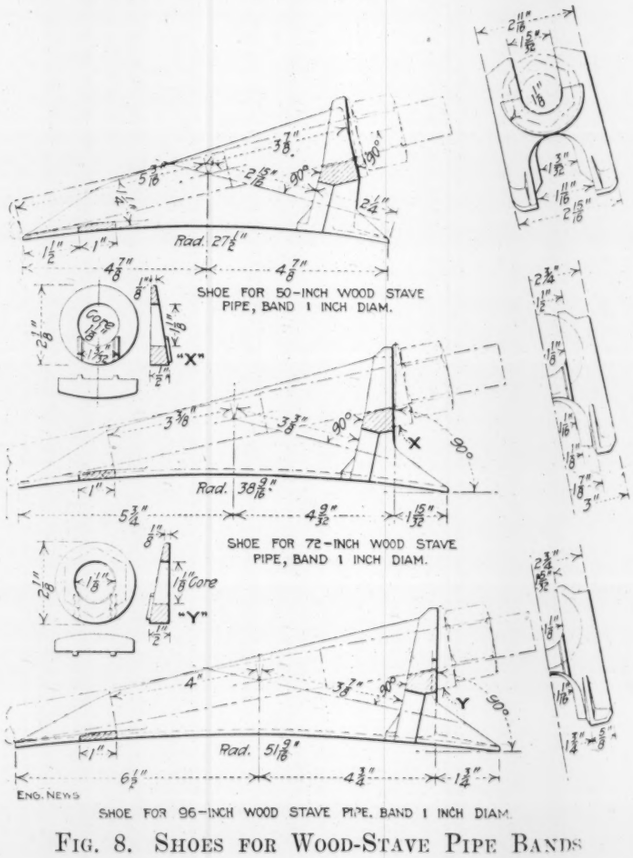
Rad. 27 1/2"
SHOE FOR 50-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.
"X"
Rad. 38 9/16"
SHOE FOR 72-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.
1/8" Core
"Y"
Rad. 51 3/8"
ENG. NEWS
SHOE FOR 96-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.

FIG. 8. SHOES FOR WOOD-STAVE PIPE BANDS

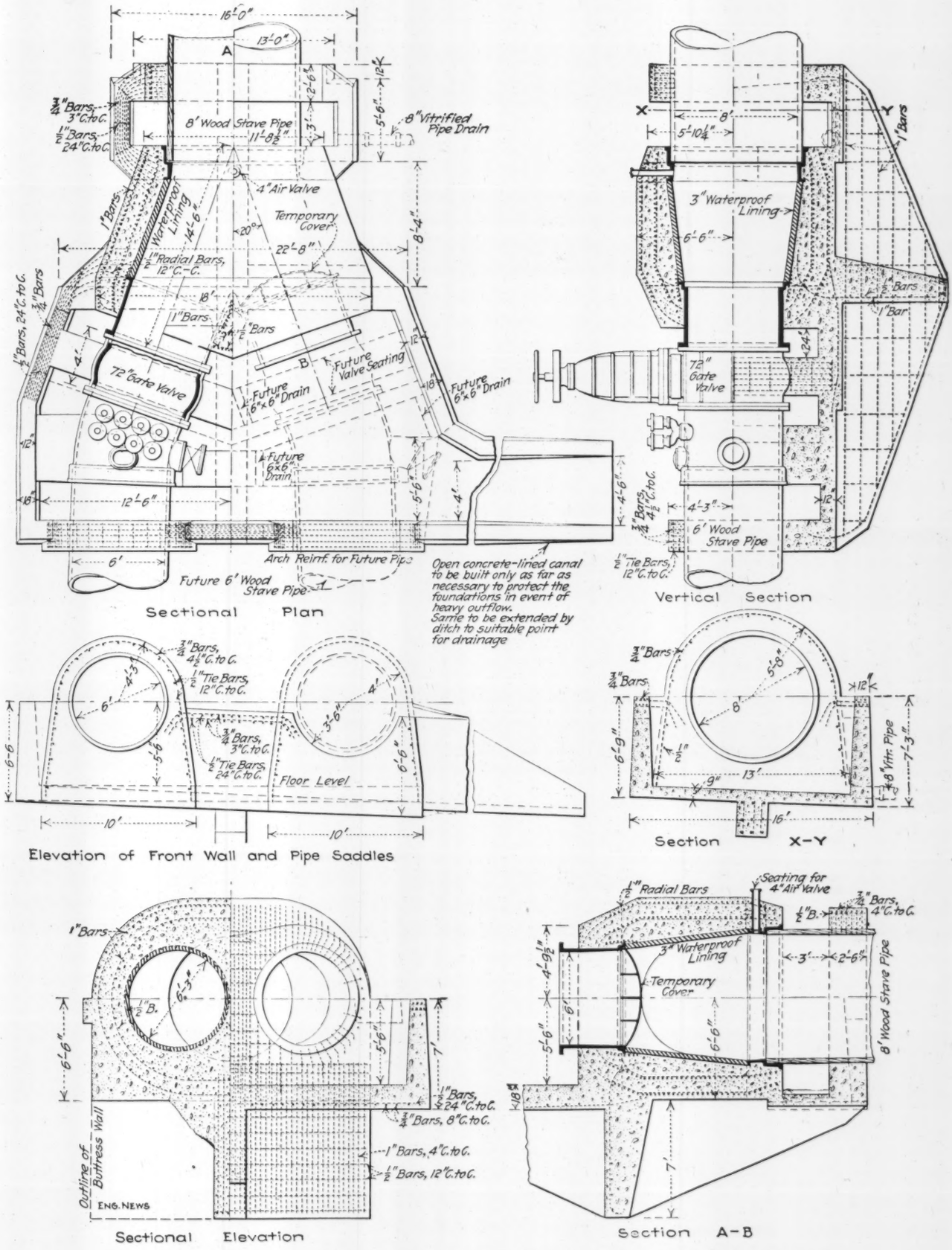


FIG. 9. A 96x72x72-IN. REINFORCED-CONCRETE HIGH-PRESSURE Y-PIPE CONNECTION

bands being less and the tangent end longer, it was deemed necessary to provide more pitch in the face of the lugs and to use tapered cast washers which lock the ends in place. The castings are of malleable iron (30,000 to 40,000 lb. per sq.in. tensile strength, elongation 2% in 4 in., any part capable of being bent or twisted 90° by hand hammering). A few shoes of each size were made from preliminary patterns and tested. Guided by

the results of these tests, the patterns were modified slightly as deemed advisable until shoes were obtained of strength equivalent to the average elastic limit of the bands, the weights of the respective shoes being held at the same time to the minimum commensurate with their strength as thus determined.

Manholes are fitted to the wood-stave pipes at intervals and particularly at summits where they are provided with automatic air valves for outlet of air during service and for inlet when the pipes are to be emptied. The manholes have cast-iron saddles with lugs designed to receive the band heads but the extreme side bands pass over the saddles, thus acting to clamp them on the pipe. The castings are not otherwise secured to the pipe. The manholes are closed with cast-steel covers bolted on the facings of the saddles.

The stave pipes are laid in a shallow trench for practically their whole length; in one depression, for a distance of 820 ft. it was deemed more advantageous to hold the grade-line elevated and to place the pipe (the 6-ft. line) on concrete piers.

Y-Junctions—Several designs were considered for the structures forming the junctions between the pipes of the different sizes. The first was for structures built of steel plates riveted in alternative forms of Y's and cylindrical headers, but after considering the size of the structures, range and nature of the stresses introduced by attaching to them stop valves in the penstocks, the designs of riveted plates were set aside as unreliable; moreover, the difference in cost between that type of structure and the design finally adopted was in favor of the latter. A second design was studied with the idea that steel castings could be made more rigid than the riveted-steel structures and could easily be provided with suitable means for anchorage; but the cost of such structures, including the necessary foundations for support and anchorage, was excessive. The design finally adopted was one in which foundations and anchorage were most conveniently combined—reinforced concrete, a type of structure believed to be unusual for such high-pressure work. The junction between the 8-ft. pipe and the 6-ft. pipes was designed for a maximum internal pressure of 115 lb. per sq.in. and that between the 6-ft. and 50-in. pipes for 160 lb. per sq.in. The 8-ft. pipe connects directly with the first Y-structure and the joint is made to a cast-iron ring set in the concrete and forming a bell end for the wood pipe. Water-tightness at the joint is obtained by the means used where the same pipe leaves the forebay. All other pipe connections with these concrete structures are similarly made with flanged cast-iron sleeves set in the concrete to which gate valves are attached. These gate valves are to enable the isolation of any one of the connecting pipes and (ultimately) the operation of the plant with one or the other of the 6-ft. and any or all of the four 50-in. lines. This explains the reason for making the lower junction structure a chamber common to the two inlet and the four outlet pipes—providing a bypass here connecting all sections of the penstock system. As will be readily understood, the introduction of stop valves in the penstock complicated the design problems as forces are developed of a magnitude not encountered in open-way penstocks.

The branches from these junction structures leave at an angle to the axis of the pipe line, and the alignment of the stave pipe parallel to such axis is restored at a short distance below each respective structure by means of cast-iron pipe bends bolted to the valves and fitted with manholes, air valves and relief valves, the latter consisting of a flanged gate valve bolted to a facing on the side of the cast-iron bend with a bursting-plate cover bolted to the outlet. Each bursting plate consists of a cast-iron flange ring within which is a cast-iron plate turned to such size as to leave an annular space of about $\frac{1}{8}$ in. The inner edge of the ring and the outer edge of the plate are grooved, the cut being narrower in the edge of the plate than that in the ring. The annular space with the grooves is filled with lead calked water-tight, it being intended to shear off the tongue of lead formed by the groove in the plate and to release the latter in the event of unexpected excessive load. To accomplish this without undue friction, the edge of the plate is turned with a taper. The thickness of the inner tongue of lead ($\frac{3}{16}$ in. in both sizes of plates) was determined after tests made to ascertain the average shearing strength of the tongue under such conditions. Automatic air valves are fitted at these structures, both for escape and inlet.

Water-tightness of the concrete structures was obtained by building the walls proper to within 2 to 3 in. of the inner surface of rich portland-cement concrete composed of fine aggregates of maximum measured density. The proportions averaged 1 : 1 : 2, the gravel varying from pea size to 1 in. The inner thickness of 2 to 3 in. was made up of 1 : 1½ portland-cement mortar. The inner surface of this coating finally was covered with several coats of asphaltum applied hot.

In the chamber of the structure for the junction of the two 6-ft. penstocks with the four 50-in. penstocks, only one-half of which is being utilized for the partial plant now built, the side which is not connected up is separated from the other by a removable wooden bulkhead, provision for which was made in the structure by rabbets armored with steel shapes set in the concrete. This feature of the design was provided on both sides in order that similar isolation of one side or the other can be readily effected at any time in the future should such be necessary for any purpose. The anchorage of the concrete structures is secured by reinforced walls approximately 7 ft. deep, buttressed to the Y-structure, and to the apron which forms the foundations for the valves and heavy cast-iron connections, the design providing amply against the overturning moment as well as against sliding. The apron referred to constitutes also the floor of a drainage basin for the relief valves, the outlet of which is an open ditch to lower ground with natural drainage to the river.

Lower End of Penstocks—Where the minimum spacing of bands is reached with four pipes (two at present), the type of construction is changed to steel pipes which are connected to the stave pipes by means of riveted-steel tapered sections joined with the wood-stave pipes by a bell end of such shape as to allow calking at the outer end of the steel section, as well as against the inner ends of the staves. This steel section has angle-bar anchoring rings riveted on and is set in a concrete anchoring block forming the base of a chamber giving access to a manhole fitted on this section. The steel pipe, which is of lockbar type, is riveted to the special steel section just described, each of these steel penstocks is 660 ft. long and their thickness varies from $\frac{3}{8}$ in. at the upper end to $\frac{7}{16}$ in. at the power house. The steel pipes are

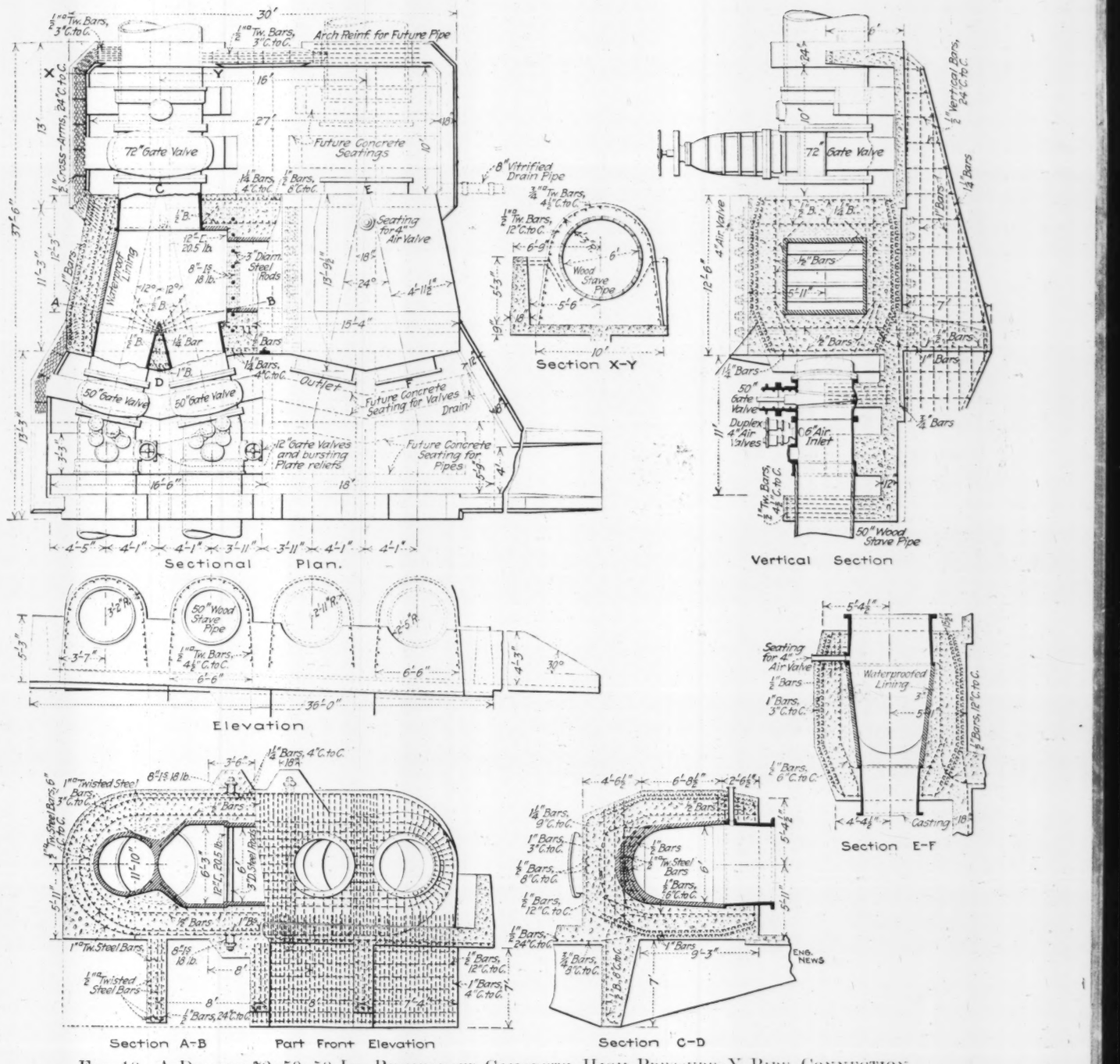


FIG. 10. A DOUBLE 72x50x50-IN. REINFORCED-CONCRETE HIGH-PRESSURE Y-PIPE CONNECTION

laid in trenches, much of which is in solid rock. At about the middle of their length there are expansion joints—steel castings with packed slip joints. Each joint is in a concrete chamber and the steel pipe is laid in tarred felt through the walls of this chamber so that it is free to slip. The lower ends of the steel penstocks are anchored near and at the power-house foundation and terminate within the building with a cast-iron closing piece connecting them to hydraulic shut-off valves installed at the respective turbines.

### POWER HOUSE

BUILDING—The power house is built of reinforced concrete on a rocky site at the river's edge; only approximately one-half of the principal building contemplated has been erected for the accommodation of the present units, but the annex section of the building which contains the switching and other electrical apparatus and the wire outlets has been built complete. Provision has been made in the design for extension of the main body of the building to house the remaining units without disturbance to the operation of the present plant.

The annex section, which is three stories high and 18½x65½ ft. in floor dimensions, has the upper floors of concrete supported by I-beams. The roof of the entire building is built of concrete laid on ribbed-steel mesh plastered underneath. The roof framing of the annex section consists of 9-in., 21-lb. I-beam rafters and that of the main section of steel trusses placed 20 ft. center to center, supporting 9-in., 21-lb. I-beam purlins. The sides

of the building are of glass in large proportion. The main building is designed with crane girders on which a 40-ton traveling crane has been installed. These girders are of reinforced concrete with embedded runway rails. All of the concrete in the exterior of the building was made with 10% hydrated lime. The roofs are covered with felt; the roof drainage is run through the interior of the building to a central drain to guard against frost in the leaders.

SCHEME OF REGULATION—The static head is 350 ft., and the length of the penstock system being 13,700 ft., the head-length ratio of the pipe is about 1:40. The part played by such a high ratio, as an unfavorable element in the problem of regulation under varying power-load conditions, was fully realized; much study was given to the general development to obtain the arrangement most favorable to good regulation, but the ratio obtained was the best possible owing to naturally unfavorable topographical conditions. The forebay is located at the

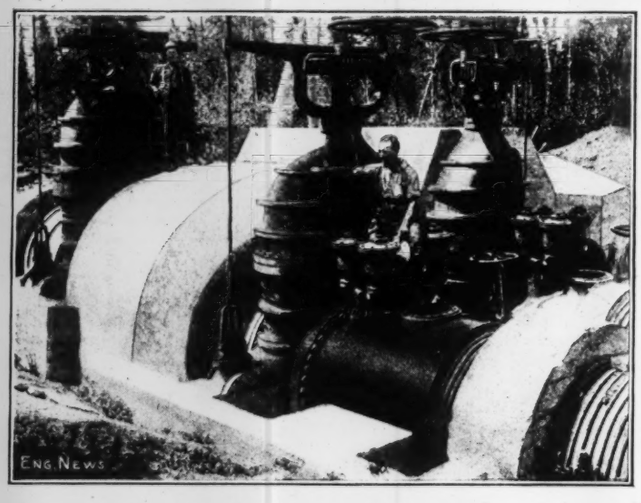


FIG. 11. THE 72x50x50-IN. Y-CONNECTION OF THE PUNTLEDGE PENSTOCK (HALF OF ULTIMATE EQUIPMENT SEEN)

nearest suitable point to the power house, the general slope increasing from this point gradually to the station site.

In a penstock system of such a high head-length ratio, it is difficult to obtain power regulation by means designed to conserve the water-supply but, inasmuch as there was no scantiness of supply and economy of water did not enter, the problem of regulation as presented was comparatively simple. The arrangement adopted, however, insures against sudden or high rises in pressure in the penstock system. Throttling of the turbine gates by the governor gear of each turbine operates a relief valve on its penstock which opens and closes with the turbine gates, thus permitting water to waste in approximate proportion to the load taken off and maintaining so nearly a uniform rate of flow in the penstock as to prevent the pressure rises due to governor throttling to exceed a nominal percentage of the pressure due to the active head. This relief-valve gear is adjustable to close in any desired length of time so that the water waste need be no more than sufficient to diminish the penstock flow at a proper safe rate. The general arrangement as designed includes, in addition to the governor-actuated relief valve, an independent direct-pressure relief valve which would open in the event of extraordinary rise in pressure caused for instance by any trouble occurring to the governor gear. In addition to the valves described, there is a safety relief—a bursting plate closing the end of a nozzle which terminates each penstock in the power house so that, in the event of accident to the governor gear and relief valves, any abnormal or dangerous rise in pressure in the penstocks would be prevented.

TURBINES—The turbines are of reaction type with governor control of multiple balanced gates at the inlet. A hydraulic shutoff valve is installed in each penstock in conjunction with the turbine. Each machine is direct connected to its generator. The specified rating of each turbine is 4700 hp. under the conditions to be obtained when the penstock system is completed and supplying four units at full power. For present purposes only two of these units are installed and inasmuch as the upper portion of the penstock system is constructed of the requisite capacity for four units, the available power of the two turbines now installed exceeds their rating to the extent of 28% for one turbine operating alone and 7½% when both are running at full gate.

The machines are placed with the shaft parallel with the longitudinal axis of the building. The floor space required for each unit is 32x50 ft. and the floor space of the ultimate power house as designed is 34x214 ft. The main building as far as constructed for the present is 34x117 ft.

ELECTRICAL PLANT—The alternating-current generators (3500-kw. 13,200-volt 500-r.p.m.) have the lower portion suspended from the foundation piers within the foundation pit. These machines are designed for a 25% continuous overload. Each machine has its exciter direct connected but the capacity of one exciter is sufficient for two machines when operating at 80% power factor.

The electrical conductors from the generator pits are laid in the concrete floor and foundations and the leads are accessible at numerous points in manholes and tunnels. The grouping of the leads from the switchboard and switching apparatus is effected in a central tunnel. The switchboard and control station are placed on an extension of the second floor of the annex, projecting as a gallery within the main portion of the building, from which the full interior of the power house proper is visible to the operator. The switching apparatus is located on the annex second floor and is contained in a series of reinforced-concrete cells. Six lightning arresters are located on the upper floor and from these the transmission lines pass out through the side of the building with the usual insulated wall entrances and attachments, which are protected by a 6-ft. awning extension of the roof.

It will be noted that there are no step-up transformers for the transmission lines. On account of the short runs no such apparatus was required, the longest line being under six miles. Most of the current is used at transmission-line voltage but step-down transformers are used in various places where the lower voltages are required.

The plant above described is now in operation and its performance is meeting all expectations. It should be noted that the storage and diversion works,, water conduit, forebay, wasteway and the upper third of the penstock system are completed for the full capacity of four units, while the lower two-thirds of the penstocks are completed only for supply to the two of these units now in operation. The cost as now constructed, figured on

the basis of the normal output capacity of the two units now installed, is less than $70 per hp. at the power-house switchboard; the corresponding cost will be reduced to less than $60 when the plant is completed and the output of four units is used. Considering the permanent character of the work throughout, the isolated location of the plant in relation to material and labor markets and the fact that a great deal of material and many appliances required for its construction had to be imported and were subject to heavy customs duties, these low costs are noteworthy.

The generators and electrical apparatus were manufactured and installed by the Canadian General Electric Co. The turbines with governor gear, the relief valves and the hydraulic penstock stop valves were furnished and installed by Escher, Wyss & Co., of Zurich, Switzerland.

The 50- and 72-in. gate valves in the penstocks and the air valves (Crispin type) were furnished by the Crane Co., of Chicago. The lockbar steel pipe was made by the East Jersey Pipe Co., of Paterson, N. J. The power-house and hydraulic-plant work was done under a general contract by Grant Smith & Co., of Seattle, Wash. Briefly, this contract embraced all of the work from the clearing of the land to and including the power house, with the exception only of the machinery and power-house apparatus. The work was begun in the late fall of 1911 and while no unusual difficulties were encountered in its execution, much delay was caused by extraordinary high water and inclement weather. The construction of the plant and installation of the machinery were supervised by the Canadian Collieries (Dunsmuir) Ltd., of which W. L. Coulson is manager and Joseph Hunter is chief engineer. They were represented on the work by L. Netland, resident engineer. The materials, fittings and structural parts purchased for the power house and hydraulic development were inspected and tested at the various places of manufacture by Robert W. Hunt & Co. under the general instructions of the owners and their consulting engineers. Plans and specifications for the work, including the detail working drawings, were furnished by the firm H. K. Owens—A. V. Bouillon, consulting civil and mechanical engineers, of Seattle.

## The City-Manager Plan at Clarinda, Iowa

[*Contributed*]

Some months ago the City of Clarinda, Iowa, adopted a plan for administering city affairs under the direct supervision of a single individual called the city manager.

The Iowa law provides for a city council composed of a mayor and one councilman from each ward of the city, and two councilmen at large. As a first step in concentration the number of wards of this little city of about 4000 inhabitants was reduced to two, thus limiting the number of councilmen to four. At the same time the size of council committees was reduced from three members to one, and these only act as advisors to the city manager. The next step was to appoint one man outside the council to act as city manager. His duties were to be those of the former city clerk, the street commissioner, the water commissioner, the sewer superintendent, and the custodian of the cemetery.

Such a man was found in the person of T. A. Wilson, a resident of Clarinda, young, industrious, energetic, with previous business experience. His office is always open to the public and all complaints received by him are registered and promptly investigated.

It has been observed that the city manager is respected by the city employees, and that they know he is liable to inspect them and their work at any moment. Several changes have been made in employees where it was evident that they were not doing their best. As a result a force of trustworthy men has been obtained.

The city employees are used interchangeably in all departments, whereas heretofore one set of employees has worked on one class of work only. Now a few men of tested worth do the work of all departments, and they are steadily employed, which is to the advantage of the city and the individual.

At the present writing, the affairs of the city are being efficiently managed—far better than under the old system as observed in other cities of its class. The several miles of street pavements and dirt roads are in far better condition than they are to be found in other cities even larger than Clarinda.

A systematic method of keeping account of the expenses of the different departments is being worked out. The city manager carefully audits all claims against the city. He is in position to do this carefully, and to the great advantage of the city over the old method where it was often difficult to trace the origin of a claim. Under the present system, practically all claims against the city are incurred on the order of the city manager, hence he is familiar with them.

Apparently the city-manager plan can be operated at less cost to the city than the commission form of government with salaried commissioners. In a small city, the salaries of commissioners are so small that they cannot afford to give their whole time to the work of the city, and if not, then it is better not to have the commissioners on a salary.

The city manager of Clarinda receives a salary of $1500 per year, and if he is retained for a few years he will, by reason of his experience in municipal work, be worth considerable more money to his city.

On the whole the city-manager plan seems to be working well in this little city. Doubtless if there were men especially fitted for this kind of work, and there are a good many, they would be worth much to the smaller towns, at least, and, in the opinion of the writer, to the larger ones as well.

It is to be hoped that the city-manager plan will be given long enough trial to prove its worth, and that it will not fall to the caprice of the ever-changing public mind before that time.

**Roads Funds from the National Forests**—The federal forest law requires that 10% of the gross receipts from the national forests shall be spent in the states in which the forests are situated. This money is expended for road improvement under direct control of the Secretary of Agriculture.

The amount appropriated under this act, based on the receipts of the national forests for the fiscal year ending June 30, 1913, is $234,638.68. From the 1912 receipts for this 10% road item, there is an additional $134,831.10, which is still available.

In administering the 10% road fund, forest officers charged with the actual plans and expenditures in the neighborhood of their forests have, in almost all cases, secured an equal or a larger coöperative fund from state authorities for the building of certain pieces of road. [U. S. Forest Notes.]

# Grade Reduction and Doubletracking on the Nashville, Chattanooga & St. Louis Ry.

The main line of the Nashville, Chattanooga & St. Louis Ry. running west from Chattanooga, Tenn. (to Nashville) has a very heavy traffic for the first stretch of 38 miles, as it is used also by the Southern Ry. as far as Stevenson* (39 miles) and by the Alabama Grea Southern Ry. as far as Wauhatchie (6 miles). This part of the line carries about 70 freight trains and 28 passenger trains per 24 hr. In order to improve the facilities for handling this traffic the line is being double-tracked between Chattanooga and Stevenson, while grade and curve reductions are being made at several points.

All grading is done by contract. The concrete bridges and culverts and other structures are built by company forces, the railway maintaining its own concreting gangs. There is only one steel structure, the Running Water Viaduct; the concrete work for this is done by the company, while the steel work is done by contract. The tracklaying and shifting is done by company force. The work is under the general direction of Hunter McDonald, Chief Engineer, and C. H. Johnson, Engineer of Construction. R. M. Milam, Assistant Engineer, is in

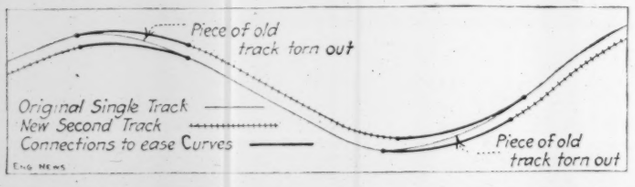
Piece of old track torn out
Original Single Track
New Second Track
Connections to ease Curves
Piece of old track torn out
Eng. News

FIG. 1. METHOD OF EASING CURVATURE IN BUILDING SECOND TRACK: N., C. & ST. L. RY.

resident charge of all the work between Chattanooga and Stevenson.

## DOUBLE TRACKING AND TRACK WORK

The double tracking has extended over about three years, being done partly in small sections by building and connecting passing tracks to form continuous stretches of double track. In double tracking where there are numerous curves, advantage has been taken of the opportunity to improve the alignment by putting the new track on opposite sides of the original track at different points. This involved a good deal of trouble in adjusting the superelevation to the new conditions, and great care was necessary also to insure keeping the track connected up so as to avoid interruptions to traffic. The two adjacent stretches of second track were completed as nearly as possible to the point at which they would intersect the single track. Then at some convenient time, with a good interval between trains, the single track was cut and its ends thrown over and lined up with the new track, as shown in the sketch plan, Fig. 1.

The width at subgrade is 33 ft. on all new work and double tracking. On the new roadbed a heavy bed of cinders is used for ballasting, as this is more easily surfaced during the inevitable settlement of the fills, and forms eventually a good sub-ballast between the roadbed and the permanent stone ballast. The new track is laid with 80-lb. and 85-lb. rails on oak ties, the ties being obtained mainly from along the Centerville and Jasper branches, and costing from 40 to 50c. each. No treated ties are used, except on bridges, where creosoted ties are standard.

On the double tracking, the ties and rails are unloaded by hand from work trains on the present track. On the new diversion line, the ties and rails will be distributed upon the roadbed by hand and push-cars.

South of Bridgeport the line crosses two arms of the Tennessee River, the bridge over the main channel having a drawspan. This stretch of line, consisting of timber trestle and steel spans, will not be double-tracked, but will be equipped with automatic block signals and operated as an isolated block section, to facilitate and protect the handling of traffic. Automatic block signals may be extended later on other parts of the line.

## CHATTANOOGA TO SHELLMOUND

The new double track commences at Cravens, about two miles out of Chattanooga, beyond the terminals and yard limits. It continues mainly on the old right-of-way as far as Shellmound (22 mi.), with few deviations from the original location, and with few changes in grade.

## GRADE REDUCTION AT CARPENTER

For about three miles near Carpenter the grade has been improved materially, an irregular profile with maximum grades of 1.1% being reduced to a more favorable profile with maximum grades of 0.5%. On the new roadbed the tracks have been laid and shifted in the manner already described, easing the curves, and connecting up passing tracks to form parts of the new main track.

In widening and lowering the cuts, the work was done in two stages. The original cut was first widened and cut a little below the original grade, and a temporary main track laid. Then the steam shovel excavated the original roadbed to the new grade, giving a width sufficient for double track.

In raising and enlarging the fills, the work was done in five stages. The fill was first widened (1) on one side to the old roadbed level; (2) then it was raised until the toe of its inner slope reached the main track. The track was then shifted to this new bank and the old fill widened (3) on the opposite side, and filling continued (4) until the inner slope reached the temporary track. This brought the new bank to the required elevation, and the main track was laid upno it, after which the bank was widened to the finished width (5) by side dumping. This arrangement of the work is shown by the profile and the cross-sections in Fig. 2.

## BRIDGEPORT-BOLIVAR CUTOFF

Between Bridgeport and Bolivar there was originally a long grade of 1% against westbound traffic and this has been eliminated by the construction of a double-track diversion line between these points. The maximum grade is 0.5%, compensated to 0.4% on the two main curves, and this grade will be extended along the present line almost into the Bridgeport station. The distance is about the same as on the old line (5 miles), but the curvature is reduced materially. About half a mile from Bridgeport the new line swings away from the old one by a curve of

*It is of interest to note that a few years ago the Southern Ry. decided to build its own line between Chattanooga and Stevenson, involving a tunnel some 3800 ft. long under Lookout Mountain. This tunnel is double-track, and was completed at a cost of nearly $1,000,000, but after the death of Mr. Spencer, President of the Southern Ry., (in 1906) the project was abandoned.

4°, beyond which is a long curve of 2°. After this there is a tangent of about 3½ miles to an easy curve of 2°, which runs into the old location at Bolivar. Fig. 3 shows the plan and profile of the cutoff line.

At the east end of the diversion there is a long and heavy cut (nearly 200,000 cu.yd.), extending almost continuously for about 7000 ft. and broken only by a few small fills. In this is the summit, with a long vertical curve. Beyond this cut there are some alternating cuts and fills, for about 10,000 ft. These are followed by a fill 6000 ft. long across swampy ground, the fill being about 15 ft. high and aggregating 155,000 yd. In this fill is a concrete slab bridge with three spans of 31½ ft., crossing Widows Creek.

The heavy cut was made with a 70-ton steam shovel having a 3½-yd. bucket. The material was a compact and flinty chert, which could not be handled without blasting, and was very hard on the drills and shovel teeth. The material will stand with a nearly vertical face. The blast holes were put down with a well drill. The shovel loaded the material into standard-gage 12-yd. side-dump cars, the loaded trains being pushed to the fills by locomotives.

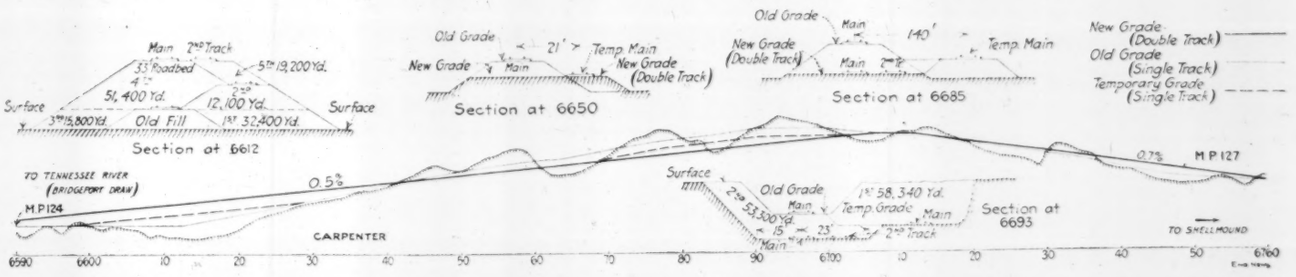


FIG. 2. PROFILE AND CROSS-SECTIONS SHOWING METHOD OF REDUCING GRADE AND WIDENING ROADBED ON AN EXISTING LOCATION

trestle of round timbers being built for this purpose. The cars were dumped (by hand) while standing on the fill, however, and only the empty cars ran out on the trestle. For the smaller cuts, wheeled scrapers were used.

### GRADE REDUCTION NEAR STEVENSON

East of Stevenson there was a long grade of 1.1% against southbound traffic, but for a distance of two miles this has been reduced to 0.3% in connection with the double tracking. This work included lowering the grade about 12 ft. through two summit cuts and raising it about 10 ft. in a long sag. This was steam-shovel work, mainly in red clay and shale and the material was handled by standard-gage dump cars and locomotives. The main summit on this part of the line remains unaltered as it occurs in a single-track tunnel 2200 ft. long under Cumberland Mountain, with approach grades of 2.5%. Plans have been considered for building a second single-track tunnel at the same or a lower grade, and also for building a new double-track tunnel at a lower grade, but nothing has yet been decided in regard to this.

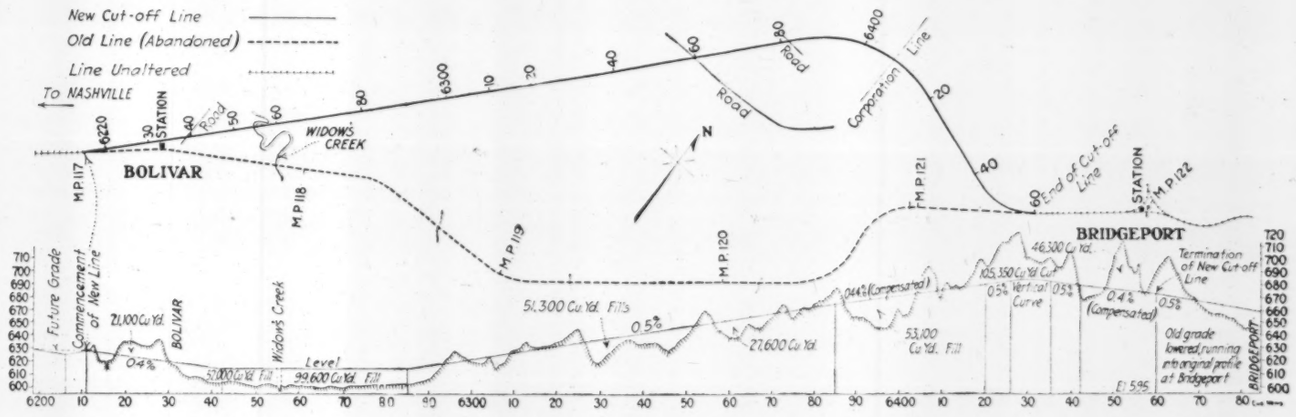


FIG. 3. PLAN AND PROFILE OF BOLIVAR-BRIDGEPORT CUTOFF LINE; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

The slope of the ground was too steep to allow of operating a construction track across it, and as it was found impossible to make a preliminary cut with plows and scrapers, the shovel (starting at the Bridgeport end) made a first through cut on a grade of about 5%, the cut being about 10 ft. deep and 20 ft. wide, and the spoil being deposited on the surface at either side. The shovel then worked back from the west end, widening and deepening the cut. As the depth was such as to necessitate working at two levels, the shovel had then to make successive cuts, working east and west alternately, and finishing to a sub-grade width of 40 ft. This will allow for slips, the standard width of roadbed for both cuts and fills being 33 ft.

The material from the heavy cuts was dumped mainly in the long fill at the west end of the line, a temporary

### SLIDES

At various points on the new work there has been trouble from slides. This is particularly the case near Raccoon Mountain, where the material is of a peculiarly broken and shattered character, and when once started

seems to continue moving almost indefinitely. There are strata of soapstone clay and shale lying on limestone ledges, and covered by boulders of sandstone and limestone that have broken from the upper levels of the mountain.

About ten miles from Chattanooga the line is in side-hill work around the base of this mountain, and a cut just beyond Hooker (10 mi.) gave continual trouble after the line was first built in 1852. To check the movement and avoid the necessity of frequent removal of sliding material dry-masonry walls were built on each side of the cut, these being founded on solid rock. The loose material continued to slide over the wall on the upper side of the cut, however, and in 1858 a masonry tunnel about 300 ft. long was built in the cut and backfilled, so that the slides might continue without affecting the railway. The tunnel is of oval section and rather small for modern clearance limits.

In double-tracking, it was decided to swing the new line outside of this tunnel and to have it in open cut, thus improving the alignment. In constructing this work in 1911 the slides were frequent, and the excavation was about 120,000 yd. instead of 80,000 yd. as estimated. However, the excavation was continued until conditions became stable, and since then there has been very little trouble. Some movement has occurred at the west end, but has been checked by driving rows of piles.

The new cut exposed the south side of the tunnel, and as it was desired to maintain the tunnel line for possible use in the case of emergency, the exposed side of the masonry has been reinforced by concrete buttresses about 30 ft. apart, to resist the pressure from the hill on the other side.

At Whiteside (14 mi.) the line again cuts across the slope of a spur of the mountain, and is partly on a hillside fill. Here the whole hillside has been in motion. Fortunately, the country is unsettled, so no great damage has been done, but some houses have been shifted bodily out of position or even destroyed. At one time the track had to be watched constantly, and a gang of men kept on hand to maintain the track in line and surface, as at any time it was liable to shift to such an extent as to endanger traffic. Material originally on the upper side of the track gradually passed under the track and forced the lower side of the fill further down the hillside.

The material slides whether wet or dry, but the trouble is aggravated by rains and by water from occasional springs, which serve to lubricate or soften a clay substratum. Tile drains were out of the question, as they would be very soon dislocated and broken. Mr. Milam proposed to put concrete conduits up the hillside, on lines of marked waterflow through the material, but this was considered to be too costly. As a cheap alternative, however, he cut trenches along these lines and filled them with loose rock in large pieces, forming French drains. There has been practically no movement since these drains were completed.

GROUTING—Near Ladds, where the line follows around the bluffs along the Tennessee River, slides have caused further trouble, and widening the bank with slag did not prove effective as the ground was not stable and therefore did not give a permanent support or footing for the new material. The plan adopted to stop the sliding was to consolidate the loose ground by grouting it with cement.

The grouting was done through a 4-in. pipe having one end tapered down to 1-in. diameter and having a number of 1-in. holes drilled in it. This was driven by hand through the slag and into the underlying material, additional sections of pipe being added as required and fitted with a driving cap. The penetration was usually 15 to 20 ft. from the surface. When the pipe was driven as far as desired, the cap was replaced with a 45° elbow, and additional lengths of pipe screwed on to give a total head of about 20 to 50 ft. (at different points). The grout was a 1 to 2 mixture, made very thin and mixed by hand. It was poured into a hopper at the head of the pipe, and the pipe was pulled up gradually as the pouring proceeded, so as to grout almost to the surface. This has proved entirely successful in preventing further movement.

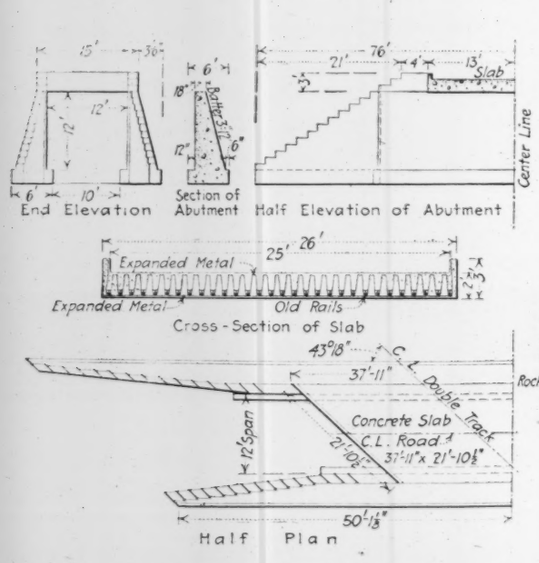


FIG. 4. REINFORCED-CONCRETE BRIDGE OVER PUBLIC HIGHWAY; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

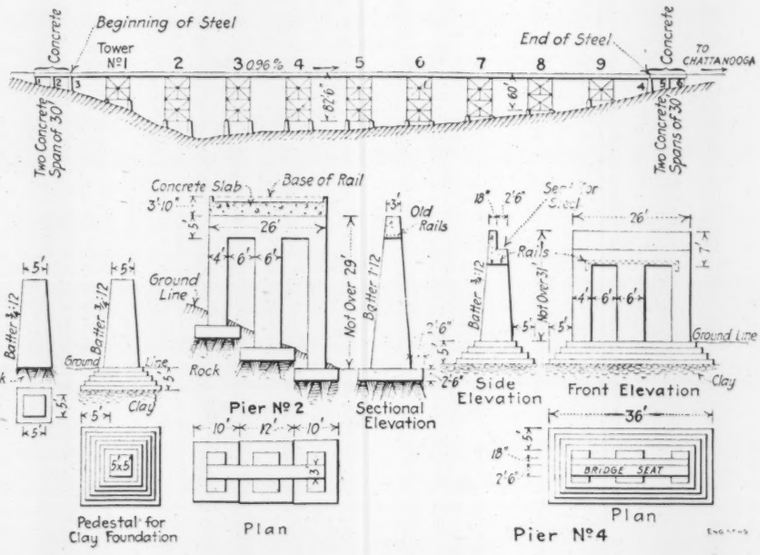


FIG. 5. RUNNING WATER VIADUCT; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

Slides and their prevention are matters of general interest to engineers on railway and other work, and in connection with the above description we may refer to the difficult work of checking a slide in a deep side-hill cut near Cincinnati, described in ENGINEERING NEWS of April 30, 1908. We may refer also to a proposed method of grouting slides so as to form underground retaining walls, described in our issue of June 5, 1913.

### STRUCTURES

Nearly all bridges are of concrete, of the slab type. The main reinforcement consists of old 52- and 58-lb. rails, of which the company has considerable quantities, and which it is found economical to utilize in this way. In the bottom of the slab is a layer of flat sheets of expanded metal, 3x8-in. mesh. Above this are expanded metal sheets bent into narrow deep troughs or loops, as shown in Fig. 4, with an inverted rail in the bottom of each trough, the spacing of the rails varying from 9 to 12 in. The depth of slab varies, of course, with the span. The standard width is 26 ft. over all, including a 6-in. curb wall 12 in. high, on each side, to retain the ballast. The concrete is a 1:2:4 mixture, using crushed stone.

In the Widows Creek bridge, mentioned above, there are three spans 34 ft. c. to c. of piers, the slabs being 33 in. thick. The piers and abutments have plain footings on piles.

Subways or bridges at road crossings are 10 to 16 ft. in clear width, and in many cases are on a considerable skew (Fig. 4). Road crossings at grade are eliminated whenever possible, and are carried under the railway in most cases. Those over the railway have concrete-slab bridges of lighter construction.

Concrete-box culverts are used for sizes of 8x8 in. and over. Pipe culverts up to 6-in. diameter are used, but are entirely incased in concrete, so that there is no liability of the joints separating. Concrete portals are used also on these pipe culverts.

### RUNNING WATER VIADUCT

Near Whiteside, there is a short diversion or cutoff which eliminates a number of curves and an old single-track steel viaduct which had the disadvantageous feature of a curve at one end. The cutoff runs straight across the valley of the Running Water Creek, and has a double-track steel viaduct 1200 ft. long with 40-ft. tower spans and 50 ft. intermediate spans. The maximum height is about 125 ft. The viaduct is shown in Fig. 5.

At each end of the steel structure is a concrete approach consisting of two 30-ft. concrete-slab spans on two piers and a back pier or abutment. The piers (Nos. 2, 3, 4 and 5) are not solid, but have each two rectangular openings to reduce the weight. The end or abutment piers (Nos. 1 and 6); however, are solid. There are no wing walls to the abutments, in view of possible movements of the approach fill on the side-hill ground. The slab spans are 34 in. thick, of similar construction to the bridge floors described above. A creosoted timber floor will be built on the steel spans and the entire deck covered with stone ballast.

The concrete pedestals and abutment piers are of 1:3:6 concrete, while the slabs are of 1:2:4 concrete. The sides of the valley are steep, and a concrete-mixing plant is installed on one side, a little below the rail level, so as to receive material by gravity. The concrete is dumped into cars running on an incline operated by cables. Concrete is delivered to the opposite side of the valley by small narrow-gage cars, handled by a hoisting engine and cable. The concrete is delivered to the forms by hand, either in wheelbarrows or wheeled buckets.

The concrete work for the Running Water Viaduct is done by contract, but all other concrete construction is done by the railway company's special concreting gangs.

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## Work in Nonferrous Metals at the Bureau of Standards*

USE OF NONFERROUS METALS FOR STANDARDS—The most fundamental and universal of all standards of measure, that of length, is defined and concretely represented by a bar of platinum-iridium alloy, of which are made the prototype meter and its copies in the possession of the various governments. The older length-standards were usually made of brass, as are the more common standard copies of the meter and yard today. Our standard of mass is also of this same platinum-iridium alloy, and here again brass is generally used for making copies. But it is not merely for our fundamental standards of length, mass and time that we may be said to be indebted to the non-ferrous metals and alloys. They permeate the whole realm of standards from electricity to heat and radio-activity. Thus the primary standard of electrical resistance is the ohm of mercury, and the working standards are coils of manganin wire. Our most exact thermometers are constructed of platinum [resistance], and the bulb of the gas thermometers used as the basis for defining temperatures is usually made of one of the alloys of platinum with rhodium or iridium. Again, the best thermocouples are constructed of the noble metals and their alloys.

Even in the restricted fields above mentioned, progress is constantly being made. To cite a single example, an excellent substitute for platinum weights has recently been found by Mr. Guillaume, of the International Bureau of Weights and Measures, in coöperation with the same firm that aided him in producing the well known iron-nickel alloy invar. This substitute, which has practically all of the requisites of a standard of mass, namely is non-porous to gases or liquids, homogeneous, non-hygroscopic, non-magnetic and non-corrosive, is an alloy of copper, chromium and nickel, the composition of which was determined only after many trials extending over a long period of time.

IMPROVING THE MANGANIN RESISTANCE STANDARD—Our electrical friends are not wholly satisfied with their manganin standard ohms, and investigations are being carried on in several places, including the Bureau of Standards in coöperation with manufacturers, in the systematic search for a better resistance material, with encouraging results.

TESTING WORK AT THE BUREAU—In metals there is a great deal of testing done for various departments of the national government. The greatest amount is done for the Isthmian Canal Commission and the Supervising Architect's office, and in addition to iron and steel it commonly ranges over some 40 non-ferrous alloys and about 20 types of coated metals, including some 500 samples per year of various bronzes, brasses and white metals, and several hundred samples of terne plate and galvanized iron. During the past fiscal year there were also 247 metallographic tests, including heat treatment, cooling curves, melting points and microscopic examination. This routine work is extremely useful for serving as a basis for supplying data upon which to base specifications.

COOPERATIVE WORK—One of the most appreciated fields of common endeavor has been the preparation, analysis and distribution of standard chemical samples, metals and metallic ores, in which several societies, many manufacturing firms and a great number of individuals have taken an active part. The Bureau will soon issue a rolled brass, carefully analyzed like its irons, steels and ores, for the purpose of checking analysts and their analytical methods. The preparation of a cast brass is also contemplated, and in fact, a sample was prepared and nearly ready for analysis, when it was spoiled in the process of mixing. This brass, containing 5% of lead, became very dark-colored during the operation of mixing in the machine specially designed for the purpose

*Extracts from a paper by Dr. G. K. Burgess, Chief of the Division of Metallurgy, Bureau of Standards, before the American Institute of Metals, October 15, 1913.

of mixing metal chips, and it was found that the lead alone seemed to have undergone marked oxidation. The sample had to be discarded and will not be replaced until some method of casting is devised that will insure the requisite homogeneity without mixing.

The experimental study now being made, in coöperation with a committee of the American Institute of Metals, at the Pittsburgh laboratories of the Bureau, of the methods of casting bronzes and brasses with a view to determining and controlling the factors that influence the tensile strength of the casting, I mention here only for the sake of completeness.

SPECIAL DETERMINATIONS—The specific resistance and temperature coefficient of copper have been experimentally determined with great exactness and thoroughness, and the Bureau's results for these constants, which are of the greatest importance to the electrical industries, have been adopted not only by the interested technical societies in America but are also recognized abroad as authoritative. Wire tables for cables based on these experiments have also been computed.

The secular behavior of manganin wire resistance standards has been studied, and the effect of moisture on their indications has been eliminated.

The radiation constants for a great number of metals have been determined at ordinary temperatures, and some progress has been made on measurements of the spectral and total radiation of metals and oxides at high temperatures, including a study of the variations with temperature. This investigation has a very practical bearing, in its application to the metallurgy of metals the temperature of which it is desired to determine during any operation; since the corrections to apply to the various types of radiation and optical pyrometers when sighted on the several metals and oxides is determined from such radiation measurements.

A matter that has bothered the chemists a good deal is the loss in weight and deterioration of platinum crucibles and ware when heated. Some work has been done at the Bureau in coöperation with a committee of the American Chemical Society, and this is still in progress.

The temperature scale is largely defined and maintained in terms of the melting points of some of the pure metals such as zinc, antimony, silver, copper, gold, palladium, platinum and tungsten. A great deal of work has been done in our laboratories and published, on the determination and reproducibility of melting-points suitable for pyrometric standards.

Recently a micropyrometric method has been devised permitting the exact determination of the melting-points of metals and alloys with quantities as minute as 0.001 mgr. Using this method the melting-points of all the refractory chemical elements are being determined.

The results on elements of atomic weight 48 to 59 have been published. In this work we are having the hearty cooperation of many chemists from all over the world. Similarly, with Sir Robert Hadfield, who furnished the samples, there are being determined the melting-points of several hundred analyzed alloy steels.

## Hopper-Bottom Steel-Frame Box Cars for Grain; Canadian Pacific Ry.

The transportation of grain is an important item in the freight business of Canadian railways, due to the remarkable development of grain-growing areas in the northwest, and a good deal of attention is paid to the proper handling of this traffic. The grain is handled in box cars, and the Canadian Pacific Ry. has introduced a special form of hopper-bottom box car designed for this traffic in order to prevent the loss of grain which commonly occurs with the ordinary box car. This loss occurs especially around the door openings, and various types of grain-doors have been invented to stop the leakage of grain. One of these new cars is shown in Fig. 1.

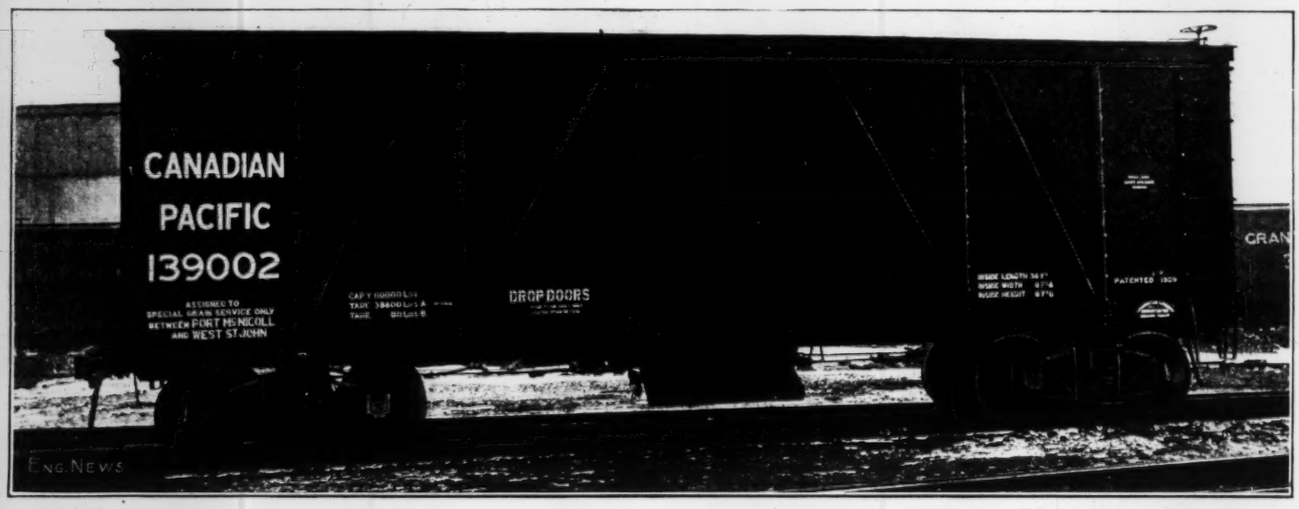


FIG. 1. HOPPER-BOTTOM STEEL-FRAME BOX CARS FOR GRAIN AND COAL; CANADIAN PACIFIC RY.

(R. W. Burnett, General Master Car Builder, Designer.)

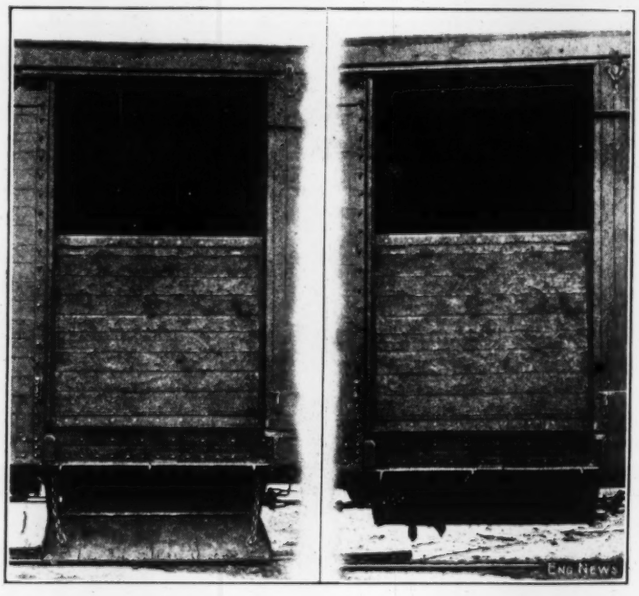


FIG. 2. STEEL HOPPERS AND UPPER GRAIN DOORS OF HOPPER-BOTTOM BOX CARS

(The hopper is shown open at the left, and closed at the right.)

In the new type of car there is a side-discharge hopper on each side, at the mid-length of the car and directly under the ordinary side-door opening. The slope of the hopper begins at the upper edge of the center sill.

The outer door of the hopper is hinged at the bottom, forming a chute when lowered and being almost vertical when closed. It is operated by hand, and is held in its closed position by lugs on a locking shaft above its upper edge, so that it cannot bulge or buckle between the fastenings. The ends of the door are flanged and when the door is closed these flanges lie in recesses or pockets formed by the side plates of the hopper. In this way a tight joint is made, which is proof against leakage, while the flanges are protected against distortion and the grooves serve to stiffen the hopper sides. The hoppers and their doors are of steel. In Fig. 2, the left-hand view shows the hopper door open, while the right-hand view shows it closed and locked.

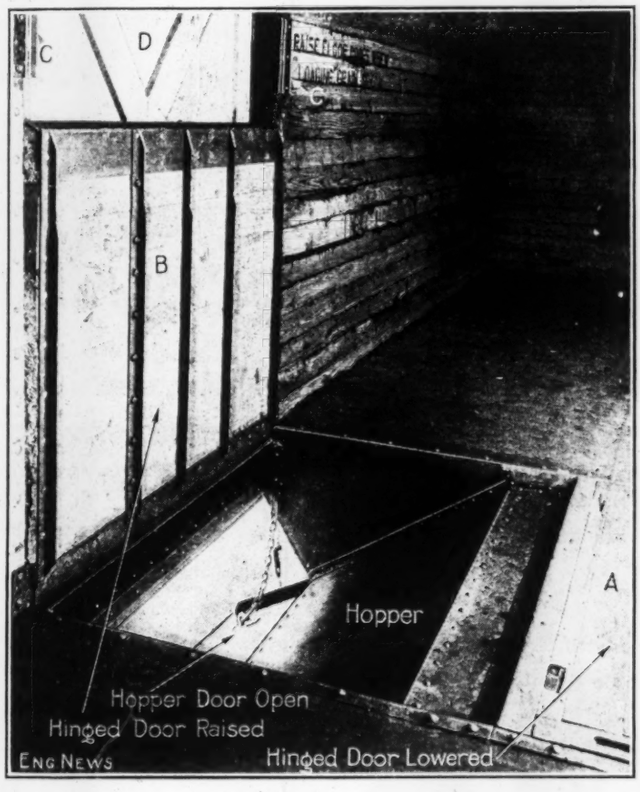


FIG. 3. INTERIOR OF BOX CAR, SHOWING SIDE-DISCHARGE HOPPER AND INSIDE GRAIN DOOR; CANADIAN PACIFIC RY.

On the inside of the car is a steel door frame hinged just inside the upper edge of the side sill, and fitted with planking. When the car is used for any traffic not requiring the use of the hopper, these two doors are lowered, and fit flush with the floor, as shown at *A*, on the right, in Fig. 3. When the car is to carry grain (or coal), the doors are raised, fitting tightly between the posts of the side doors, while the bottom closes against the side sill so that there can be no leakage over this sill. This is shown at *B*, at the left, in Fig. 3. Above the door are placed Z-bars *C*, on each side of the opening, so that if the car is to be loaded to a height above the level of this door, planks can be fitted between the Z-bars, above the door. The regular sliding side doors are closed and secured, of course, as at *D* in Fig. 3. In Fig. 2, however, the side door is open in order to show the special grain-door formed by raising the hinged section of the floor.

It will be seen that full reliance is placed upon the hopper doors to prevent leakage at the hoppers, no auxiliary door or partition being fitted. The efficiency of these doors in this respect is due to the peculiar fitting of the edge and sides against the corresponding parts of the hopper, as noted above. To test this efficiency, the hopper is filled with flax-seed and then jarred by striking it with a hammer, the vibration tending to cause the seed to flow almost as freely as water. The cars are required to stand this test, and we are informed that no loss of grain has been detected since these cars were put in service late in 1912.

In unloading grain, the locking shaft of the hopper door is revolved so as to release the door, which then falls open to a position limited by the side chains. About half the load will flow out through the hoppers. Then the inside doors can be lowered to the floor, the outer sliding doors opened, and the remainder of the grain swept out by power shovels or scrapers in the usual way. The unloading is said to take only 66% of the time required with ordinary box cars.

The hopper and folding-door equipment cost about $50 and increase the weight about 800 lb., as compared with the ordinary box car. But the latter will require special inside grain doors and attachments when used to carry grain, so that when cars of the two kinds are loaded with grain there is little difference in their weight. The extra cost, also, is largely (if not entirely) offset by eliminating the expense of fitting, and removing temporary grain doors (with their nailing strips and attachments) in the ordinary cars.

A special feature of these new cars is that they are designed with a view to hauling grain to the coast and coal on the return trip, thus reducing the empty mileage and getting greater service from the cars, while reducing the amount of equipment required for special classes of service. They can be used also in ordinary freight service.

About 200 of these hopper-bottom box cars have been built, and it may be noted that they are steel-frame cars, with the plank side sheathing attached to the inside of the steel body framing, as shown in Fig. 1. They are mounted on arch-bar trucks. In inside dimensions they are 36 ft. long, 8 ft. 6 in. wide and 8 ft. high. The rated capacity is 80,000 lb., and the weight of car empty is about 38,600 lb. The cars were built by the Canada Car & Foundry Co.

This type of hopper-bottom box car has been designed and patented by R. W. Burnett, General Master Car Builder of the Canadian Pacific Ry., and we are indebted to him for photographs and information.

⁂

**Five Railway Valuation Districts,** each approximating 50,000 sq.mi. of territory, have been announced by the Interstate Commerce Commission. The districts, with their headquarters cities (in parenthesis) are as follows:

EASTERN—(Washington, D. C.), Connecticut, Delaware, District of Columbia, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

SOUTHERN—(Chattanooga, Tenn.), Alabama, Florida, Georgia, Indiana, Kentucky, Mississippi, Ohio, Panama, Porto Rico, South Carolina and Tennessee.

CENTRAL—(Chicago), Arkansas, Illinois, Iowa, Louisiana, Michigan, Minnesota and Wisconsin.

WESTERN (Kansas City), Colorado, Indian Territory, Kansas, Missouri, Nebraska, North Dakota and Texas.

PACIFIC—(San Francisco), Alaska, Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

# The St. Louis Mechanical Water Filters

By Edward E. Wall*

*SYNOPSIS—The author outlines the history of the St. Louis water-supply, from the viewpoint of quality, for about fifty years past. Plain sedimentation and sedimentation aided by coagulation have been tried with improving results as to quality and now filtration, recommended by the late James P. Kirkwood, in 1869, is to be added, but rapid or mechanical, instead of slow sand filters, are being built.*

❖

There is now under construction at the St. Louis Water-Works a filter plant with a rated daily capacity of 160,000,000 gal. When completed it will be the largest rapid sand filter plant in the world. A brief resumé of the condition, quality and treatment of the St. Louis water-supply will be necessary in order that the reader may follow the course of events that led up to the final conclusion to install filters.

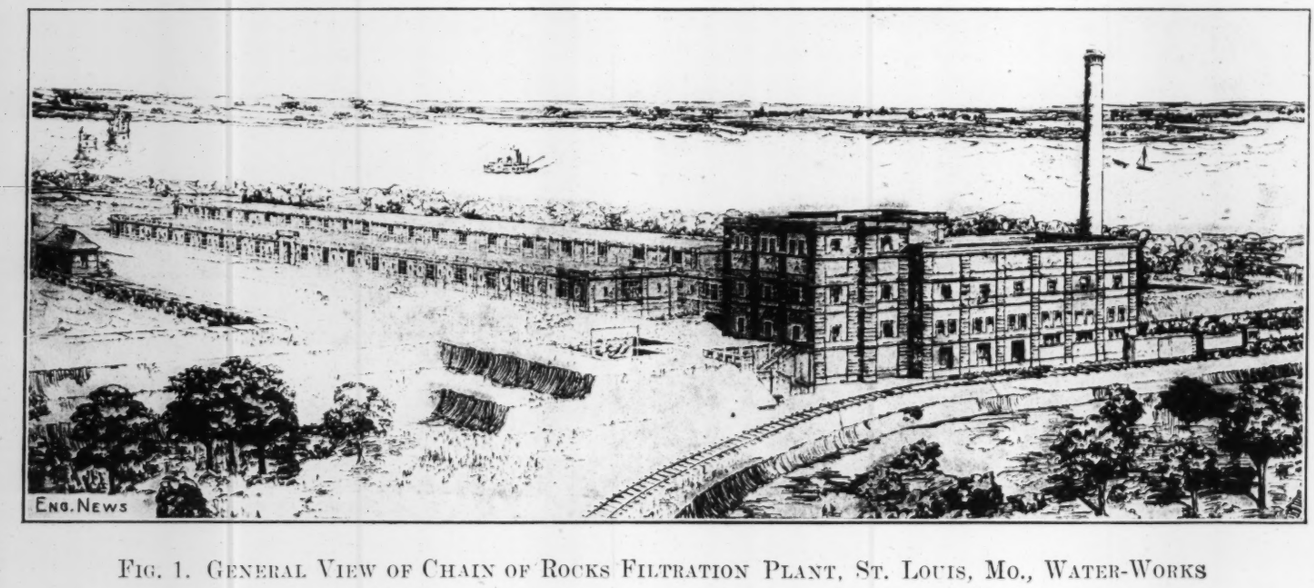


Fig. 1. General View of Chain of Rocks Filtration Plant, St. Louis, Mo., Water-Works
(E. E. Wall, Water Commissioner. Roth & Study, Architects.)

Until 1904, St. Louis was supplied with untreated Mississippi River water, which had undergone a few hours of plain sedimentation before being pumped to the consumer. The tap water carried from 50 to 600 p.p.m.† of suspended matter, the average turbidity for the year 1902 being about 200. The river water for the same year ranged in turbidity between 100 and 7000 p.p.m., the average being about 2000.

As long ago as 1865 the Board of Water Commissioners sent the late James P. Kirkwood, then chief engineer of the water-works, to Europe, "to inform himself in regard to the best process in use for clarifying river waters used for the supply of cities, whether by deposition alone, or by deposition and filtration combined, making such an examination in each instance as will enable him to report to this Board the general dimensions and special characteristics of the specific works visited by him, so that this Board may be able to appreciate how far the same mechanism and the same or similar combination of materials are likely to be adaptable to the purifying of the Mississippi water at St. Louis."

The following year Mr. Kirkwood made a voluminous report to the Board, recommending slow sand filters, and outlining a tentative design for their construction. The Board did not see fit to follow his recommendations, and the filtration scheme was dropped. In 1869, Mr. Kirkwood writes: "the public mind of St. Louis, so far as it has been expressed, does not yet seem inclined to consider filtration important."

The Board finally adopted plans for new works at Bissell's Point, deciding to depend for clarification upon plain subsidence in settling reservoirs, in the face of Mr. Kirkwood's statement that "they [settling reservoirs] would be an experiment which it might be interesting to have made, but which could not be advised, that I know of, on the faith of its having succeeded elsewhere."

During the years between 1865 and 1900, the desirability of improving the appearance of the water-supply was agitated from time to time, the general belief being that the river water in its natural condition was exceptionally pure and healthy, and only needed to be clarified to silence the complaints of over-sensitive persons of finical taste.

Because of the inadequacy of the Bissell's Point works to supply the growing city, the construction of new works, located at the Chain of Rocks, about ten miles above the business district of the city, was started in 1887. This plant, completed in 1894, and which is still in use, was designed along the same lines as the Bissell's Point works, but with a much larger capacity of settling reservoirs.

When the Chicago Drainage Canal was put in service in 1900, the typhoid death rate began to increase and fil-

*Water Commissioner, St. Louis, Mo.
†Parts per million.

tration was again proposed, this time by Edward Flad, then Water Commissioner, who submitted plans for mechanical filters to the Board of Public Improvements.

Mr. Flad's experience was very similar to that of Mr. Kirkwood, thirty years earlier, and he, also, might well have said: "the public mind of St. Louis does not seem inclined to consider filtration important."

In 1904, a method of clarifying the water by coagulation and flowing sedimentation was put in operation under the direction of the writer. The original design was fully described in ENGINEERING NEWS, Nov. 26, 1903, and later (Oct. 27, 1904) a further account was published in the NEWS, giving in some detail the changes in design brought about through some months' experience with the process of clarification. Other articles by the writer, published in the NEWS, Feb. 20, 1908, and Jan. 11, 1912, described the evolution of the equipment and the operating results of the process.

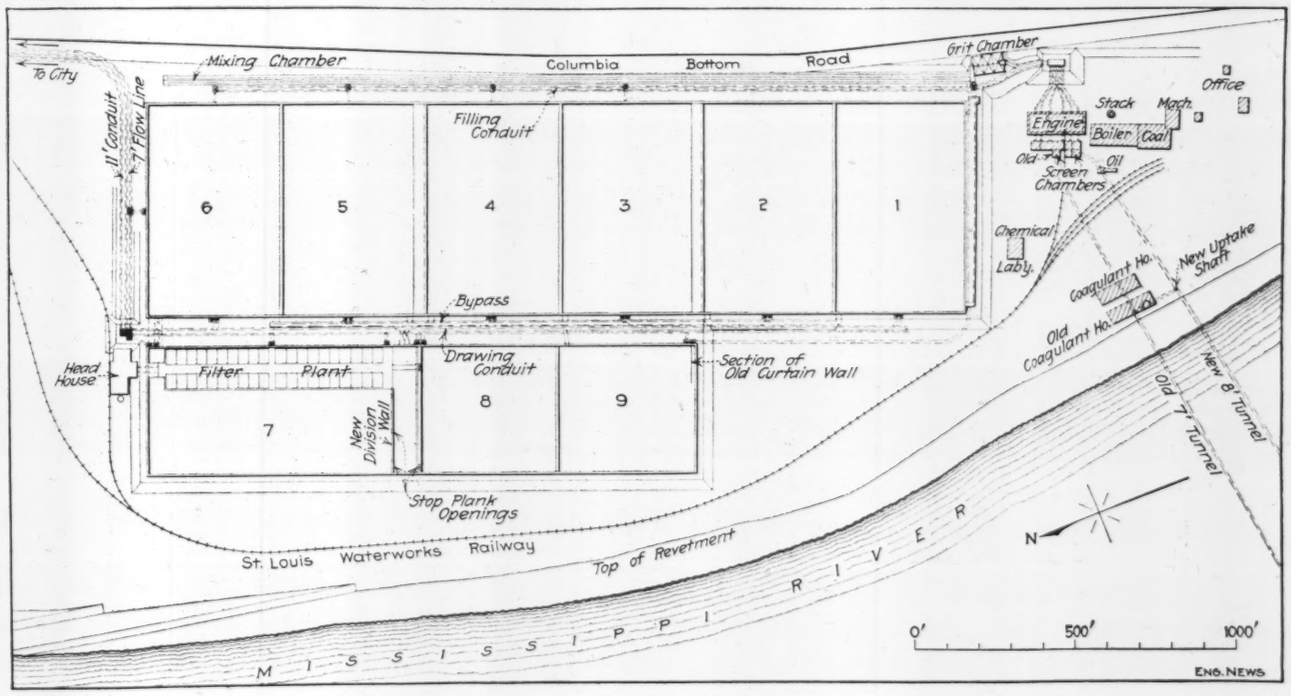


FIG. 2. GENERAL LAYOUT OF NEW FILTER PLANT AT ST. LOUIS WITH REFERENCE TO OLD SEDIMENTATION BASINS

The instantaneous and remarkable improvement in the water-supply of the city encouraged the engineering force of the Department to persist in their efforts to perfect the rather crude original apparatus and treatment, and to eliminate some objectionable features resulting therefrom. After three years' experience it became evident that the capacity of the existing settling reservoirs was insufficient and two new basins were added, increasing the settling capacity from 180 to 250 million gallons.

Toward the end of the year 1911, the necessity of a still greater clarification capacity became so apparent that the system of operation had to be rearranged, in order to admit of greater flexibility in the use of the basins.

The results of the treatment of the river water from 1904 to the present time show very clearly two very grave defects in the process: (1) The water supplied to consumers varied considerably in quality, owing to the wide range in the suspended matter in the raw water, combined with the irregular pumping which varied with the daily consumption, on account of the limited storage capacity for clear water. The maximum pumping frequently coincided with the periods of maximum turbidity of the river water so that at these times the clarification was incomplete. (2) The second defect in the process lies in its inefficiency for color removal. At times the Mississippi water runs over 100 p.p.m. on the platinum scale. With a color of 30 in the river water, a reduction to 12 or less is possible, but a color of 100 parts cannot be reduced below 45. In the autumn of 1911, the color of the water entering the St. Louis intake ran very high, with a maximum of 115 p.p.m., and for several weeks the settling basins contained an exceedingly dark-colored water, and the consumers' faucets delivered an amber-colored liquid, which caused innumerable complaints.

The average daily consumption of water for the year 1911 was 7,400,000 gal. greater than for 1910. This unexpected increase brought home the fact that the waterworks, as a whole, was being operated practically to its full capacity, while the clarification capacity was heavily overtaxed. It seemed to the writer that a definite plan, comprehensive enough to supply the needs of the city for a considerable time in the future, should be worked out and adopted.

On Nov. 1, 1912, the writer submitted to the Board of Public Improvements a report on the capacities and conditions of the various divisions of the water-works, with recommendations for improvements, extensions and new works supplementing the present works, providing sufficient capacity to supply the city until 1960. The report analyzed the capacity, results and efficiency of the purification process since its installation in 1903, compared the cost of increasing its capacity to 150,000,000

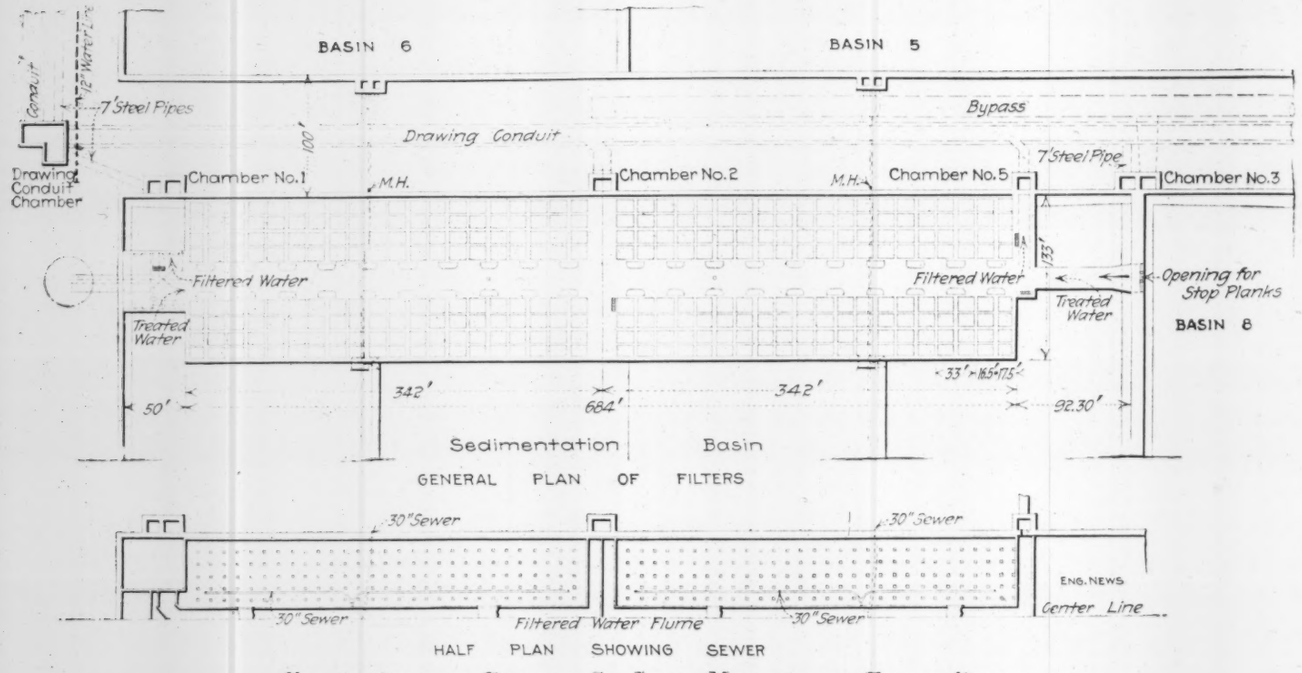


FIG. 3. GENERAL PLAN OF ST. LOUIS MECHANICAL FILTER PLANT

gal. per day, with the cost of building rapid sand filters to supply 160,000,000 gal. per day, reaching the conclusion that the filter plant would not only be more economical to construct and operate, but would also insure a more uniform and better quality of water.

This report recommended that the present works, as a whole, be enlarged to provide a working capacity of 150,000,000 gal., this being the limit to which they could be economically increased. Provision for a greater supply should, in the writer's opinion, be made by the establishment of new works on the Missouri River about 16 miles west of the city, at an ultimate cost of approximately $20,000,000.

The Board of Public Improvements approved the recommendation to enlarge the present works, to construct the rapid sand filters and to build a new intake tower and tunnel. The total cost of the proposed improvements was estimated at $3,075,000, including certain additions and extensions to the pumping plants and distribution system. Within sixty days after the approval of the general scheme by the Board, plans and specifications for the filter plant and the tower and tunnel were submitted, approved and forwarded to the Municipal Assembly, with bills appropriating $750,000 for the construction of the first and second sections of the work. Contracts for the filters, filter equipment and the tower and tunnel have been let, and the construction is now in progress. Bids for the construction of the filter house will be asked for in a short time.

Plans for the head-house are practically completed. Fig. 1 is a general view of the new filter plant as it will appear when completed and Fig. 2 shows the arrangement of basins, conduits, chambers, filters and connections. There will be forty filter units, each 50x28 ft. in plan. The filters are being built in the western part of Sedimentation Basin 7, and will occupy a space approximately 700x140 ft. (Figs. 3 and 4). On the original basin floor inverted-concrete arches are laid to distribute the foundation loads of the columns supporting the filters. Each concrete filter box will be poured as a monolith on the 9-in. reinforced floor joining the columns.

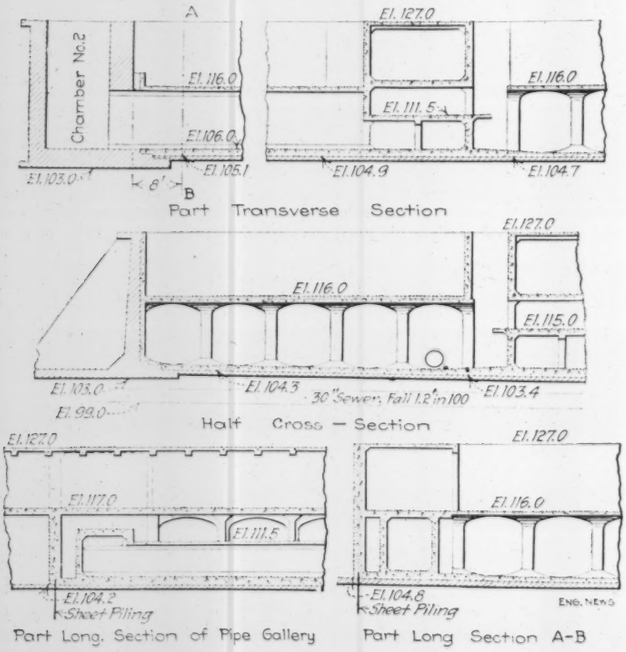


FIG. 4. SELECTED PORTIONS OF LONGITUDINAL AND CROSS-SECTIONS, ST. LOUIS FILTER PLANT

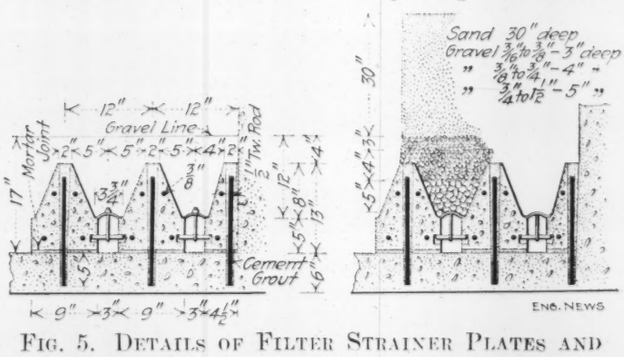


FIG. 5. DETAILS OF FILTER STRAINER PLATES AND ARRANGEMENT OF GRAVEL AND SAND, ST. LOUIS FILTERS

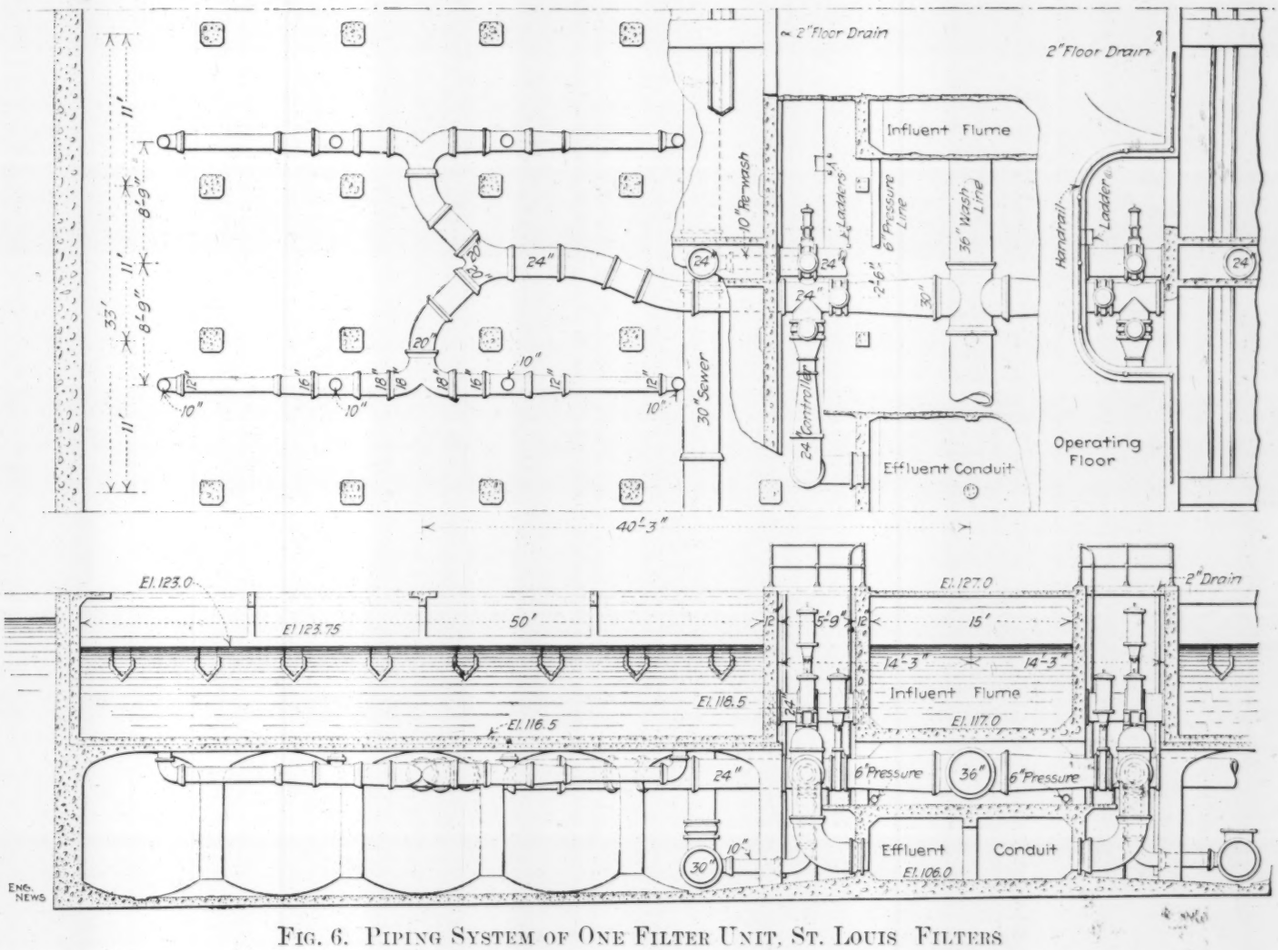


FIG. 6. PIPING SYSTEM OF ONE FILTER UNIT, ST. LOUIS FILTERS

The concrete in the arches and columns will be a 1:2½:5 mixture, while that in the filter boxes and conduits will be 1:2:4. All the coarse aggregate will be gravel, screened and washed.

The floor of the filter is of the well known V-shaped bottom with bronze strainer plates anchored to the concrete blocks by bronze bolts, as shown in Fig. 5. A channel 3 in. wide and 5 in. deep under each strainer plate empties into the main collecting channel, 28 in. wide and 5 in. deep, of which there are two to each filter unit, and which are drained through eight 10-in. openings connected by cast-iron pipe to the effluent conduit, as shown by Fig. 6. The sizes of the gravel and sand and the depths of the several layers of each are shown in Fig. 5. The bronze wire screen, which usually separates the gravel and sand in filter installations, will be omitted. The sand will have an effective size from 0.40 to 0.50 mm. and a uniformity coefficient not greater than 1.65.

The pipe gallery (Fig. 7) is 28½ ft. wide. It will contain the effluent conduit, 15 ft. wide and 4½ ft. high, built of reinforced concrete, over which lies the cast-iron wash-water pipe, 36 in. in diameter, to which each filter unit is connected by a 24-in. pipe. Above this is the influent flume, 15 ft. wide and 10 ft. high, also built of reinforced concrete, into which the water from the secondary coagulating basins can be drawn at either end of the filter house. Two main sewers, 30 in. in diameter, will carry the wash water from the filters, and all drainage to the river. Directly under the filters, branches from the main sewers will be connected to all the wash-water troughs.

On the effluent pipe of each unit will be placed a rate

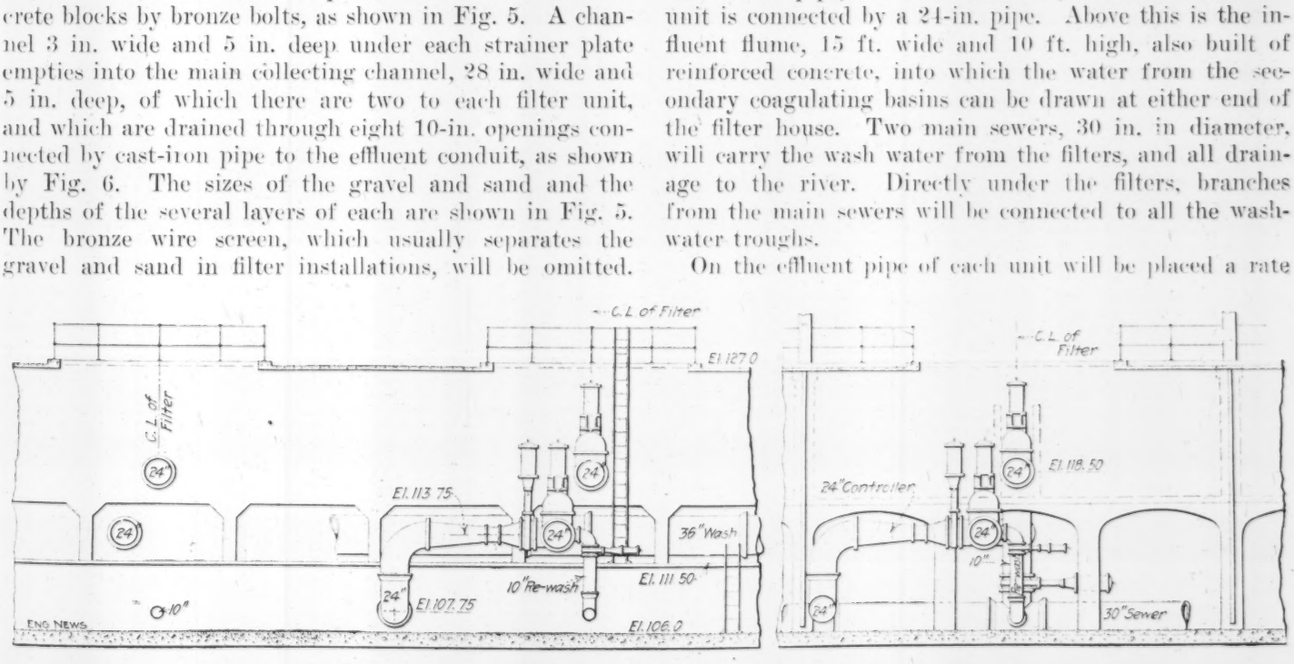


FIG. 7. LONGITUDINAL SECTION THROUGH PIPE GALLERY, ST. LOUIS FILTERS

controller, capable of constantly maintaining any desired rate of flow between 1,500,000 and 5,000,000 gal. daily, regardless of the difference in head on the two sides of the controller, which may amount to as much as 14 ft. The variation between the actual and the registered flow shall not be more than 3% of the registration when it is below 2,500,000 gal. per day, and not more than 1½% when it is above that amount.

Each controller will be provided with suitable mechanism for setting it at the desired rate of flow, and will also be connected to a general controlling device, which, when set at any desired rate of flow, will automatically set all the unit controllers at the same rate. Each unit controller will be equipped with a mechanism for recording on one chart the actual rate of flow, the loss of head and the elevation of the water on the filter.

There will be a Venturi meter placed on the 36-in. wash-water pipe, which will indicate and record all flows up to 42,000 gal. per min. The water level in the effluent conduit will be indicated and recorded by a gage placed at the outlet at the center of the filter house.

Operating tables of the usual type, equipped with valve levers, gages, sample pumps, etc., will be located on the operating floor of the central gallery.

The filter house will be built entirely of concrete, with metal window sash and frames. The building will fully inclose the filters, the ceiling beams being 11⅔ ft. above the operating floor at the side walls. On account of the depth of the main beams supporting the roof, they will be projected above the roof 19 in., to give a uniform depth to all beams inside the building. The lantern will be the full width of the central gallery, and extend 6½ ft. above the main roof. The building, 699x134 ft., will be heated from a steam plant on the ground floor of the head-house, which will be located 34 ft. south of the filter house.

The head-house will be a four-story concrete building, containing on the first or ground floor, three 150-hp. boilers, four alum-solution tanks, two alum-solution pumps, three 12-in. centrifugal pumps for supplying the wash-water tanks, two 6-in. pressure pumps for hydraulic valves, a four-ton refrigerating plant for manufacturing ice for the Department, a storeroom for chemicals (hypochlorite of lime and liquid chlorine) and a small machine shop; on the second floor will be located an office, a small laboratory, six alum-mixing tanks, washrooms, lockers and storeroom; two wash-water tanks, each 50 ft. in diameter, and containing 175,000 gal. of water between working levels, will occupy the greater part of the third and fourth floors. The dome-shaped covers of these tanks will form part of the roof of the building. Also on the third floor will be the solution tanks for hypochlorite of lime and the liquid chlorine apparatus.

There will be space on the fourth floor for the hypochlorite-mixing boxes, and storage for alum. Coal, alum and other supplies will be delivered in cars on a switch running along the south side of the head-house. Alum will be unloaded from the cars directly into an elevator, which will deliver it to the storage bins on the fourth floor. The alum solution will be pumped from the head-house to the chamber north of the filter house, while the hypochlorite solution, when used, will be conducted through fiber pipes to the drawing-conduit chamber, where also liquid chlorine will be applied, if it is used.

The present method of operating the settling basins wholly or in part in series, will be abandoned, and they will be used in parallel.

The division walls between basins, which were cut down in 1904, will be rebuilt, and Basins 1, 2, 3, 4, 5, 6 and 9 will be used as primary coagulating basins. Basin 8, and that portion of Basin 7 not occupied by the filters, will be used for secondary treatment with alum when necessary. The water turned on the filters will not carry more than 40 p.p.m. suspended matter. The water will be drawn from the primary basins in a concrete collecting conduit, varying in height from 3½ to 7 ft., in

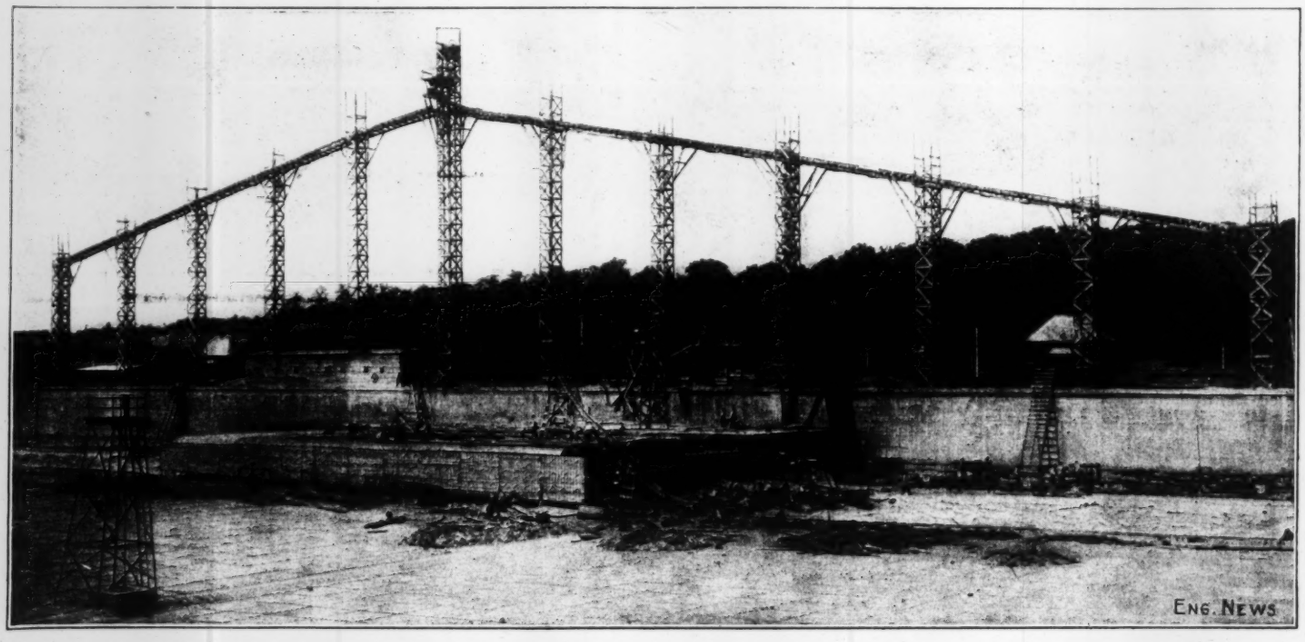


FIG. 8. ST. LOUIS FILTERS UNDER CONSTRUCTION, SHOWING CONCRETE MIXING AND PLACING PLANT

(The 40 mechanical filter units, each 50x28 ft. in plan, are being built upon the concrete floor of one of the existing sedimentation basins. The floor of each unit consists of inverted groined arches, which support the columns which carry the roof of the filters.)

width from 14 to 26 ft., located between the first six basins and Basins 7, 8 and 9. This collecting conduit will deliver the water into either Basin 7 or 8 through a chamber at the north end of the filter house, the flow being measured by Venturi meters. Whatever secondary treatment is necessary will be applied to the water as it enters this chamber, or just before it goes on the filters.

Before the water reaches the primary basins, and before any chemicals are added, it is proposed to pass it through a grit chamber 60x100 ft. in plan, located as shown on Fig. 2, where the heaviest of the suspended matter will precipitate, and which will be flushed out as often as necessary through a 36-in. sewer to the river. As the water leaves the grit chamber it will receive the charge of lime, and enter the mixing chamber, 30 ft. wide, 2400 ft. long and 11 ft. deep, divided into four channels, located as shown on Fig. 2.

These channels may be used singly, forcing the water to travel 9600 ft. from the grit chamber to the filling conduit, or they may be used in pairs, reducing the distance traveled one-half. Or by changing the stop planks, 1200 ft. south of the grit chamber, one-half of the mixing channels may be cut out of service.

The object of this design is that the carrying capacity of the mixing channels may be varied to follow more nearly the irregular pumping, so that the velocity of water throughout its course may be maintained sufficiently high to prevent settlement in the conduit.

The charge of sulphate of iron will be applied to the water as it leaves the mixing channels and enters the filling conduit, from which it is delivered to the basins. Each inlet to the basin will be baffled, so as to prevent any direct flow across the basin to its outlet. Both the solution of sulphate of iron, and the milk of lime will be prepared at the present coagulant house, and pumped from there to the points of application.

Under the present system of clarification, the average quantities of lime and iron sulphate per gallon of water used last year were respectively 5.23 and 2.97 grains, 12,448 tons of lime and 7082 tons of iron sulphate being used. Through the use of the grit chamber and mixing channels, the quantities of lime and iron sulphate will unquestionably be considerably reduced.

The water will be softened to the same extent as under the present process, except that at times the permanent hardness may be slightly increased through the use of alum in the secondary basins.

The entire work of building the filter plant, making all changes and connections to existing structures, and constructing the grit chamber and mixing channels will be completed and in operation on or before Jan. 1, 1915, which will be less than two years from the time that the Board of Public Improvements approved the general scheme and authorized the Water Commissioner to prepare plans and specifications.

The principal contractors for the work now under construction are as follows: substructure and concrete filter boxes, McCormack-Coombs Construction Co., St. Louis, Mo., $225,024; filter equipment, Pittsburgh Filter Manufacturing Co., Pittsburgh, Penn., $398,200.

The completion of this work, with certain proposed extensions and additions to the pumping plants and to the distribution system, will bring the water-works of St. Louis to a working daily capacity of 150,000,000 gal. of water, clear, sparkling and absolutely pure.

# The Illinois Law for Licensing Mason Contractors*

The Illinois legislature has passed a law "to provide for the licensing of mason-contractors and employing-masons and to regulate the safe and proper construction of buildings." It applies to all cities having a population of over 150,000 and as originally introduced it specified a license or certificate fee of $200 (good for one year), with a charge of $100 per annum for renewal of the license. As passed, the amounts of the fees are left to the decision of the city council, so that the force of the law is weakened considerably. Few cities have yet taken action under the law. It is required that a board of examiners shall be appointed by each city within three months from the passage of the law, and rules and regulations governing mason work prescribed within the same period. The law is given below, practically in full:

1. In all cities of this State of 150,000 inhabitants or over, every mason contractor or employing mason shall be required to obtain an annual license therefor, in the manner following:

2. Every person desiring to engage in the business of mason contractor or employing mason shall make application to a Board of Examiners, and shall, at such time and place as said board may designate, be compelled to pass such examination as to his qualifications as said board may direct. Said examination may be made in whole or in part in writing and shall be of a practical and elementary character but sufficiently strict to test his qualifications.

3. In every city of 150,000 inhabitants or over, there shall be a Board of Examiners of mason contractors or employing masons, consisting of three members, one of which shall be the Building Commissioner, who shall be ex-officio chairman, one shall be a practical architect and one shall be a practical mason, who shall be appointed by the mayor and approved by the city council within three months after the passage of this Act, for the term of one year from May 1 in the year of appointment and thereafter annually before May 1, and shall be paid from the treasury of said city such sum as the officers may designate.

4. Said Board of Examiners shall, as soon as may be convenient after appointment, meet and shall then designate the times and places for the examination of all applicants desiring to engage in or work at the business of mason contracting or employing masons within their respective jurisdiction. Said board shall examine said applicants as to their practical knowledge of masonry and mason construction and all matters pertaining to mason construction and, if satisfied of the competency of such applicants, shall thereupon issue a certificate to such applicant, authorizing him to engage in the business of mason contracting or employing masons.

The license or certificate fee for such mason contractor or employing mason shall be fixed by the common council. Said certificate shall be valid and have force throughout the State for a period of one year from date of issuance, and may be renewed upon its expiration by paying in advance an annual renewal fee to be fixed by the common council. All fees received for said license or certificate shall be paid into the treasury of the city where such certificates are issued. Provided, that wherever a firm or corporation consists of more than one master or employing mason, it shall not be necessary for more than one member of said firm or corporation to procure a license certificate.

5. Each city shall, by ordinance or by law, within three months of the passage of this Act, prescribe rules and regulations for the materials, construction, alteration and inspection of all mason work placed in or upon or in connection with any building in said city; and the Building Department shall provide that no mason work shall be done upon any building without a permit being first issued therefor upon such terms and conditions as such city shall prescribe.

6. All persons who are required by this Act to take examination and procure a certificate as required by this Act shall apply to the board in the city where he resides or to the board nearest his place of residence.

7. Any person violating any provision of this Act shall be deemed guilty of a misdeameanor and shall be subject to a fine of not less than $5 nor exceeding $50 for each and every violation thereof, and his certificate may be revoked by the proper authorities in said city.

**Engineers vs. Lawyers or Progress vs. Precedent**—Until the past few years the language of specifications was to a great degree modeled after that commonly used in legal documents—some of it verbose in the extreme. Many of these wordy expressions may be traced back to the days when compensation for drawing up legal papers was largely dependent on the number of words they contained. The efforts of a number of clear-headed writers among the engineering profession have brought about a decided improvement in this direction, and many of the newer specifications are models of concise expression.—Kirby's "The Elements of Specification Writing."

*The builders license law now in force at Boston, Mass., was given in our issue of Oct. 2.

# FIELD AND OFFICE

## Construction Trestles with Old Rails for Stringers

In the reconstruction of the line of the Pennsylvania R.R. at Rahway, N. J., the Keystone State Construction Co. has a considerable length of timber trestle in which the stringers are made of old rails discarded by the railway. These trestles are of two types, one used as a construction railway and the other as a filling trestle which is covered by the fill as it progresses. They are both detailed in the accompanying cuts.

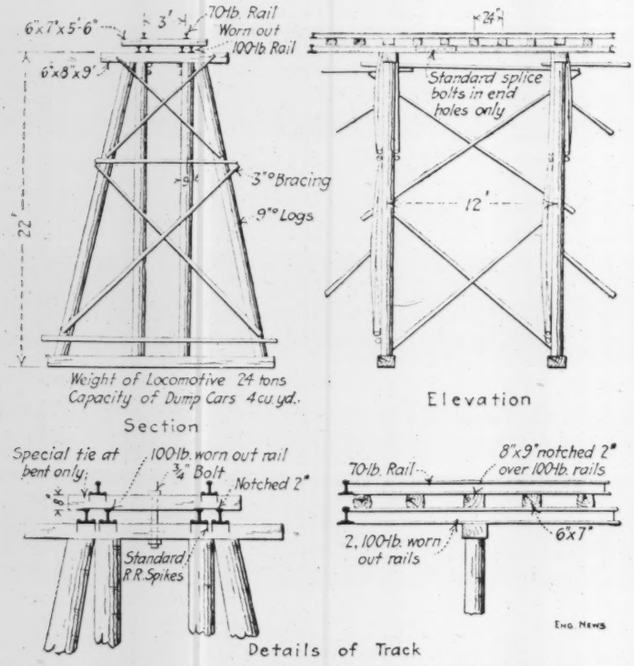


FIG. 1. CONSTRUCTION TRESTLE WITH RAIL STRINGERS
(Pennsylvania R.R. track elevation, Rahway, N. J., The Keystone State Construction Co.)

The construction railway trestle is the heavier of the two (Fig. 1). It is made up of the usual framed bents with round log uprights and sapling braces and a squared 6x8-in. cap. On this cap run the stringers, four old 100-lb. rails, in groups of two, spanning the 12-ft. opening between bents. These rails are spiked with standard railway spikes to the cap and are spliced wherever the breaks come with the standard rail splices with bolts only in the end holes.

The 3-ft. gage construction track is built of old 70-lb. rails spiked to 6x7-in. ties with an 8x9-in. tie dapped 2 in. over the stringer rails at the bents. These latter ties are bolted with ¾-in. bolts to the bent caps, and this is the only fastening of the track to the bents or stringers.

The filling trestle is shown in Fig. 2. In it the track rails also act as stringers. This track is of 3-ft. gage and is made up of old 100-lb. rails, spiked to 6x7-in. ties, which act merely as spacers between bents and as caps at the bents. The dirt train is backed onto the trestle and the cars are dumped at the edge of the fill so that

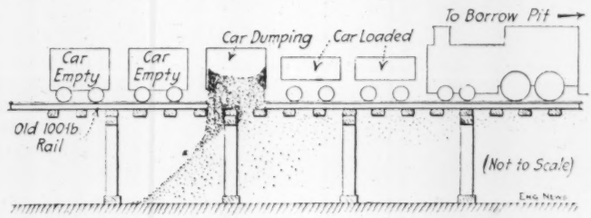


FIG. 2. FILLING-TRESTLE WITH TRACK SPANNING BETWEEN BENTS

no load but that of empty cars comes on the trestle. The ties and rails remain in the fill and form the construction track on the embankment.

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## Building with Traveling Tower-Cranes

Derricks are almost unknown in European building construction work. Hoisting with hand tackle or with hand-winch elevators is very common. Ordinary building construction includes no heavy interior parts, on account of the limited height of buildings and the virtual absence of steel framing in European practice, and therefore the principal lifting of heavy weights arises in connection with the stone-facing work of the front wall. Under these circumstances, a steel tower crane was introduced about ten years ago by Karl Voss, Berlin, and being both cheap and convenient in use, it has become very popular. Traveling tower cranes of other types are built by various concerns, and almost every building-erection job in Germany at the present time makes use of one form or another of traveling crane.

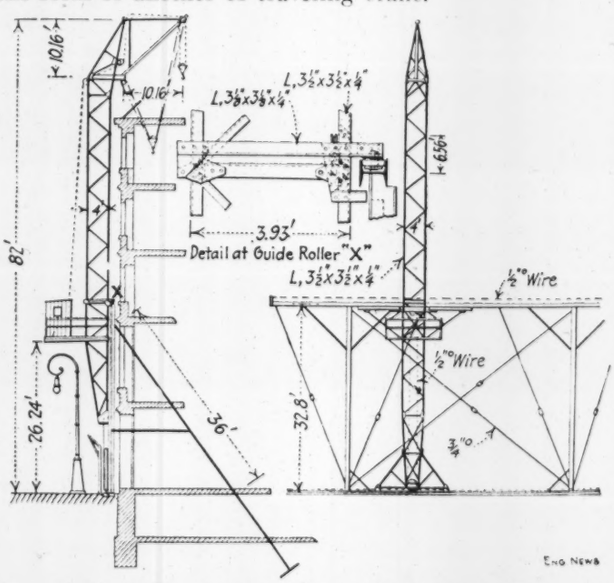



FIG. 1. VOSS TRAVELING TOWER-CRANE FOR BUILDING ERECTION

The drawing, Fig. 1, herewith, shows the general construction of the Voss crane, in its present-day form. The tower is a square four-post steel structure of small horizontal dimensions, supported at the base on a two-wheel track running on a rail laid on the ground close along the front of the building. The tower is held by a horizontal guide roller below midheight, engaging a horizontal I-beam supported by posts and stayed by back legs. On top of the tower is supported a small rotatable crane or derrick, with a reach of about 10 to 12 ft. The operating winches for the crane are on the operator's platform, some distance up the tower. Electric operation is preferred where current is available.

The guide-rail framing of the crane is braced longitudinally by knees and rod diagonals. The backstays are I-beams or channels extending diagonally downward from the guiderail to suitable anchorages or supports in the interior of the building. The method of providing this anchorage is various, depending upon the conditions, but in any event the provision for these braces is not a very great complication. According to the concern which handles (rents out) the Voss crane, Voss & Wolter, of Berlin, the backstays need not be spaced closer than about 30 to 35 ft. apart.

Fig. 2 shows a view of a building site where four of the above cranes are in use, mainly for handling the facing stones. This is a monumental building in Munich. In the erection of a new building for the Deutsche Bank, in Berlin, now under construction, a single such crane is used on a building block about 120x200 ft., the street front being 120 ft. long. A store building in Cologne, of reinforced concrete, with a front of about 200 ft., also used only one crane.

Some cranes used for the same purpose as the one above described rest on a four-wheel truck and are self-contained, needing no guiderail. In this case the crane is made somewhat larger in horizontal dimensions and the rotating crane-arm on top swings the full circle, which is not the case with that shown in Fig. 1.

The heights of these cranes are such that they reach to the roof, which means 85 to 110 ft., the height of buildings being everywhere restricted by law and custom. Capacities of 2 to 3 tons are usual.

As to the cost, it may be said that the cranes are nearly always hired by the builder. The rental depends on conditions, of course, but according to statements of the firm of Voss & Walter the total charge for erection, rental and removal amounts to $0.06 to $0.07 per square foot of front wall surface.

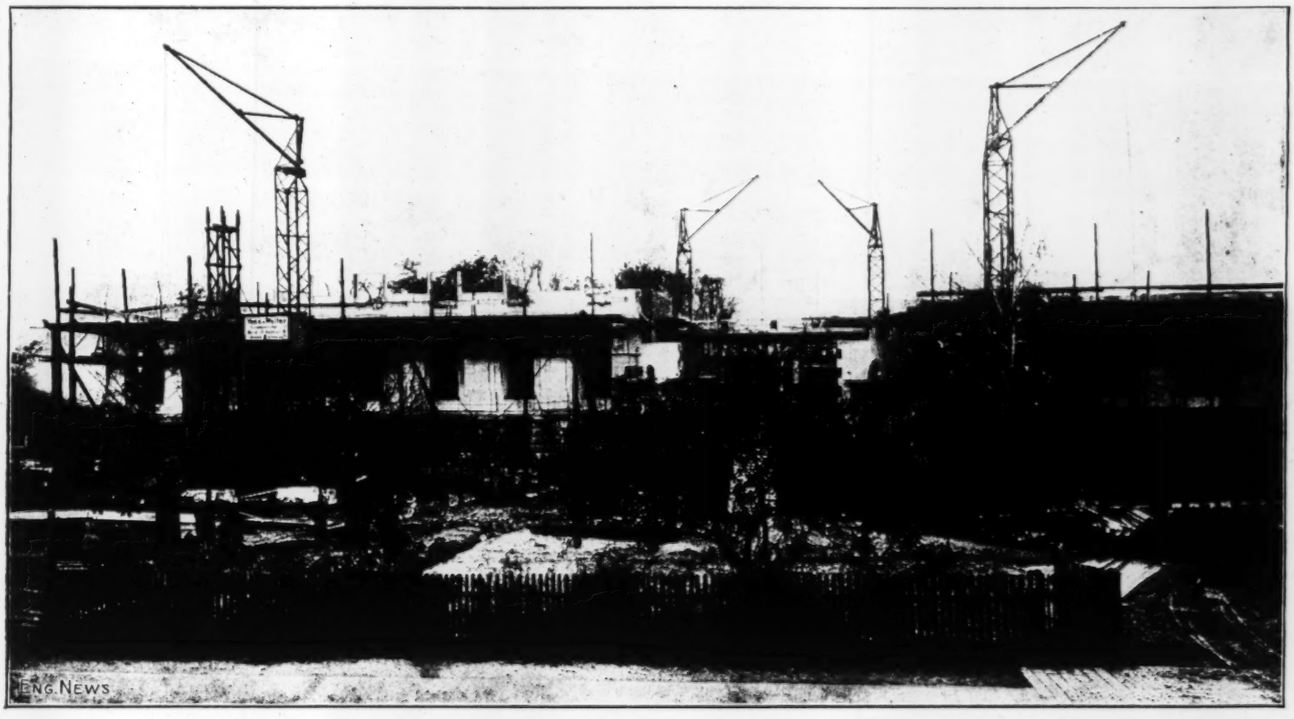



FIG. 2. FOUR TOWER-CRANES ERECTING A MONUMENTAL BUILDING IN MUNICH

**Loading Formulas for Crane-girders**—When a crane-girder is to be designed, the capacity of the crane which it must carry is given, but the make of the crane often is not. The cranes of different makers, though built for the same capacity, do not have the same weight per wheel or the same wheel spacing, and the designer must therefore design the crane-girder for a particular crane, or else design with sufficient margin to include all makes of crane. Ernest Owen, Martins Ferry, O., offers formulas for amount and spacing of crane wheel-loads, for use in designing crane girders, in place of crane tables of various makers. Letting

C = Capacity of crane, tons;
S = Span of crane, feet;
W = Wheel-load, thousands of pounds;
D = Spacing of wheels, feet;

the wheel-load is

$$W = 5.1 + \frac{C}{0.85 - 0.0935\,S}$$

and the wheel spacing is

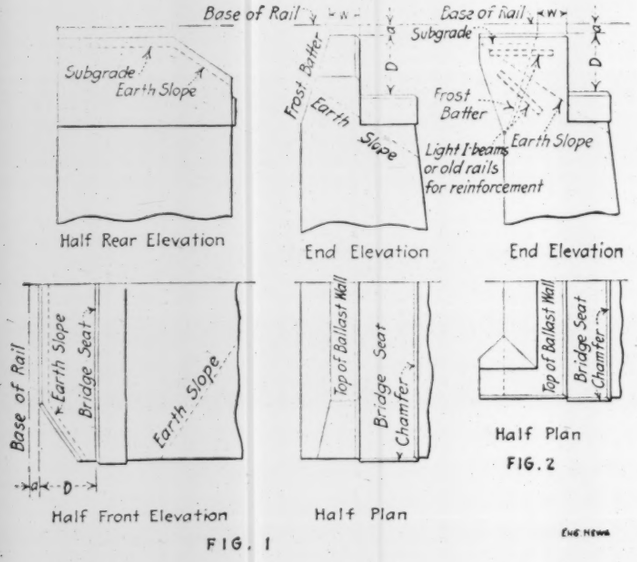
$$D = 7 + \tfrac{1}{10}\,C + \tfrac{1}{10}\,S$$

He says that this formula is based on data taken from the standards of various bridge companies and various crane-builders' catalogs, and has been found to give satisfactory results for electric cranes ranging in capacity from 3½ to 60 tons.

# The Design of Concrete Abutments Without Wing Walls for Deck Girders

By C. M. Luther*

In designing concrete abutments for railway bridges, there are certain occasions when it is permissible to let the earth fall in front of the abutment: in other words, certain conditions justify construction of abutments without wing-walls. When such is the case, care must




be taken to see that the earth does not encroach on the bridge seat.

Assuming that the bridge seat is at some distance above the surface of the ground, the following points enter into the design as important factors, in so far as the question of keeping the earth away from the bridge seat is concerned:

1. Rate of slope of the backfill.
2. Width of the ballast wall proper, and rate of frost batter on back of same.
3. Distance $D$ from the bridge seat to the top of the ballast wall.

In addition to these, the length of the bridge seat as compared with the width of the subgrade or roadbed, and the distance from the subgrade to the top of the ballast wall, also require consideration, the discussion of which, however, will be omitted, as the difficulty arising from these adjusts itself to the circumstances in many cases.

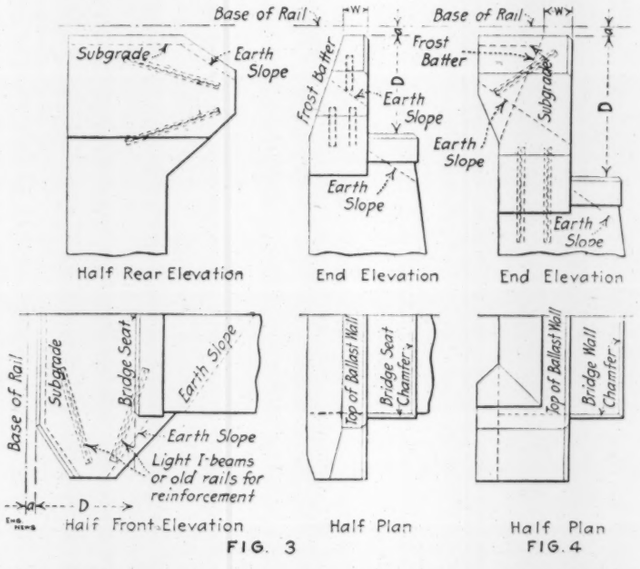
A rock backfill presents but little trouble in this respect as compared with dry, loose earth backfill. This is equivalent to saying that, other factors being the same, the steeper the slope of the backfill, the easier would the solution of the problem be. This can readily be seen by a glance at the accompanying figures, and does not need any further explanation.

The width of the ballast wall is generally taken from 1 ft. 6 in. to 2 ft. 6 in. for ordinary abutments; and there are conditions which forbid the designer to take excessive width. The frost batter on the back of the ballast wall can profitably be made light in abutments for through girders, as in that case the distance from bridge seat to ballast wall is comparatively small. Most engineers prefer to have the width of the horizontal section of the ballast wall on the plane of the bridge seat not less than one-half the distance from base of rail to bridge seat. This may be stated by the formula $W + Db = \frac{D + a}{2}$ in which (see Fig. 1)

$W$ = Width of the ballast wall on top;
$D$ = Distance from the bridge seat to the top of the ballast wall;
$a$ = Distance from the top of the ballast wall to the base of rail;
$b$ = Rate of the frost batter per unit of height.

If this practice is indorsed, ballast walls of abutments for deep deck plate-girders must necessarily be given greater width on top and heavier frost batter on back. The wider the ballast wall and the heavier its frost batter, the further would the earth fall from the bridge seat.

When $D$ is small the problem is comparatively simple: and in fact in many cases a ballast wall of ordinary width with an average frost batter, coupled with slight changes from an ordinary design, is enough to prevent the earth from running on to the bridge seat. This is particularly true in the case of abutment designed for through plate-girders, in which $D$ seldom exceeds 4 ft. Fig. 1 illustrates an abutment of this class. It must be noticed that for through bridges the ballast wall proper is shorter than the bridge seat; so that the earth will start to fall along the side of the abutment at a considerably lower point than it would have done were the ballast wall proper longer than or equal to the bridge seat. Therefore, the excess of the length of the bridge seat over




that of the ballast wall proper will of necessity, help the matter considerably.

In the case of an abutment for short deck plate-girders, in which $D$ is same as in Fig. 1 but the bridge seat, instead of being longer than the ballast wall, is practically of same length, to attain the desired object the ballast wall is turned at its ends, parallel to the center line of the track, with a battered surface on its back (Fig. 2). In this case the earth begins to fall along the side of the abutment from the level of the subgrade, but at a considerable distance back from the face of the ballast wall.

*Designing Engineer, Mackenzie, Mann & Co., Ltd., Toronto, Can.

In cases for long deck plate-girders, however, in which $D$ varies from 7 ft. to 12 ft. or even more, it is difficult to keep the backfill from encroaching on the bridge seat in ordinary abutments, unless short wing walls are provided. Fig. 3 shows an abutment without wing walls,

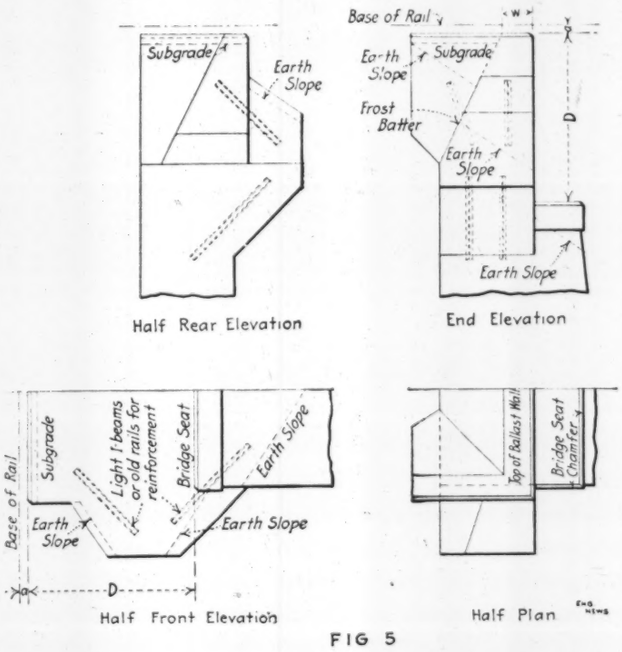



FIG 5

intended for deck plate-girders, suitable for cases in which $D$ is about 7 ft. or under. To attain the point in view, the ballast wall proper is extended, following the slope of the backfill, and retaining the frost batter of the ballast wall as well, forming a short cantilever. For lack of better terms, we will call these extensions *lugs*. The earth slopes down along the back and to the end of the lug; then turns along its side at some distance below the subgrade, which is determined by the length of the lug, and the slope of the backfill. These lugs are reinforced with light I-beams or old rails. This type of abutment has been extensively used by the Canadian Northern Ry. on their Eastern Lines and has been found very satisfactory.

For same slope of the backfill, the greater the distance $D$, the longer will the lugs be; so that higher values for $D$ call for excessively long lugs, which are, of course, objectionable. But by modifying the ballast wall, or the lug or both, as the case may require, the matter can be considerably simplified. Fig. 4 shows a design in which $D$ is about 10 ft. In this case the ballast wall is turned at its ends, parallel to the center line of the track, with a battered surface on the back, and a short lug attached on the front.

Fig. 5 shows another type with some modifications, having nearly 13 ft. for $D$. The ballast wall has been turned and battered on the back, as in the preceding case, while part of the front of the turned portion is vertical. The lug instead of starting from the top of the ballast wall, starts at some distance below, depending upon the slope of the backfill, length of the turned portion of the ballast wall and the frost batter of the lug itself.

In these types the ballast wall proper is taken equal to the width of the subgrade, or roadbed. These cases have been cited to serve as simple examples. Special cases must be given special consideration. It is believed that these abutments can profitably be adopted when conditions warrant having the earth partly cover the breast of the substructure. There is, undoubtedly, considerable saving in concrete, in this design, which would not be feasible where short wings are used.

A design is sometimes used similar to that shown in Fig. 4, except that it has little curtain walls on the sides of the bridge seat, extending from the face of the ballast wall toward the breast of the abutment, and following the earth slope. This design, however, calls for unnecessarily long bridge seat, unless the curtain walls are properly reinforced and then projected beyond the sides of the bridge seat. The vertical surface on the bridge seat may also be objected to, on the ground that undesirable material may accumulate between the girder and the adjacent wall, especially when the bridge seat is comparatively short. Furthermore, the girders during erection may hit the thin curtain walls and demolish them.

## A Bridge Abutment with Cantilever Wings

A special form of concrete bridge abutment is used in the bridges crossing the Datteln-Hamm Canal, in western Germany, now under construction. The canal passes through a coal-mining region, where the ground practically everywhere is subject to subsidences up to a num-

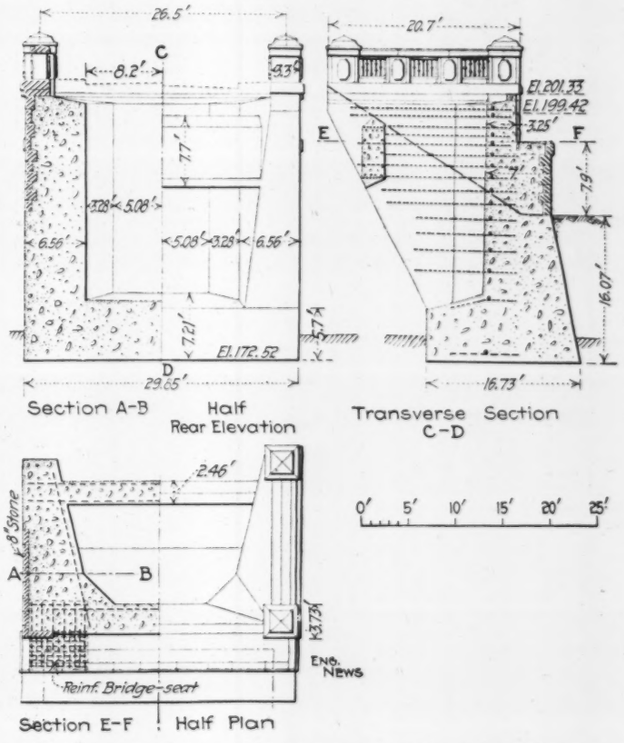



FIG. 1. TYPICAL BRIDGE-ABUTMENT PIER AS USED ON NEW CANAL FROM DATTELN TO HAMM, RHENISH PRUSSIA

ber of feet. While more or less continuous, these subsidences are quite irregular in their distribution along the canal, and also irregular as to time of occurrence. Various special constructions were used in the canal work to provide against injurious or disturbing effect of future

subsidences, and among other items the bridge abutments had to be so designed that they would not be in danger of being broken apart when settlement tends to tilt or shift them. A drawing and some photographic views herewith show the type.

The abutment consists of a pier and two rearward wings, which, however, are cantilevered out from the pier and do not rest on bases of their own. As the danger of injury from settlement is about in proportion to the size of the base of the structure, in this case the abutment was made as small as possible in ground plan, that is to say as compact as the allowable soil pressure and other conditions permitted. The whole abutment is made of reinforced concrete. The upwardly sloping wings, which are parallel to each other and to the center line of bridge, are not retaining walls, but act as beams in retaining the earth, being held by the body of the pier from which they project, and at their outer end by a transverse tie. Their inner faces are vertical, so that

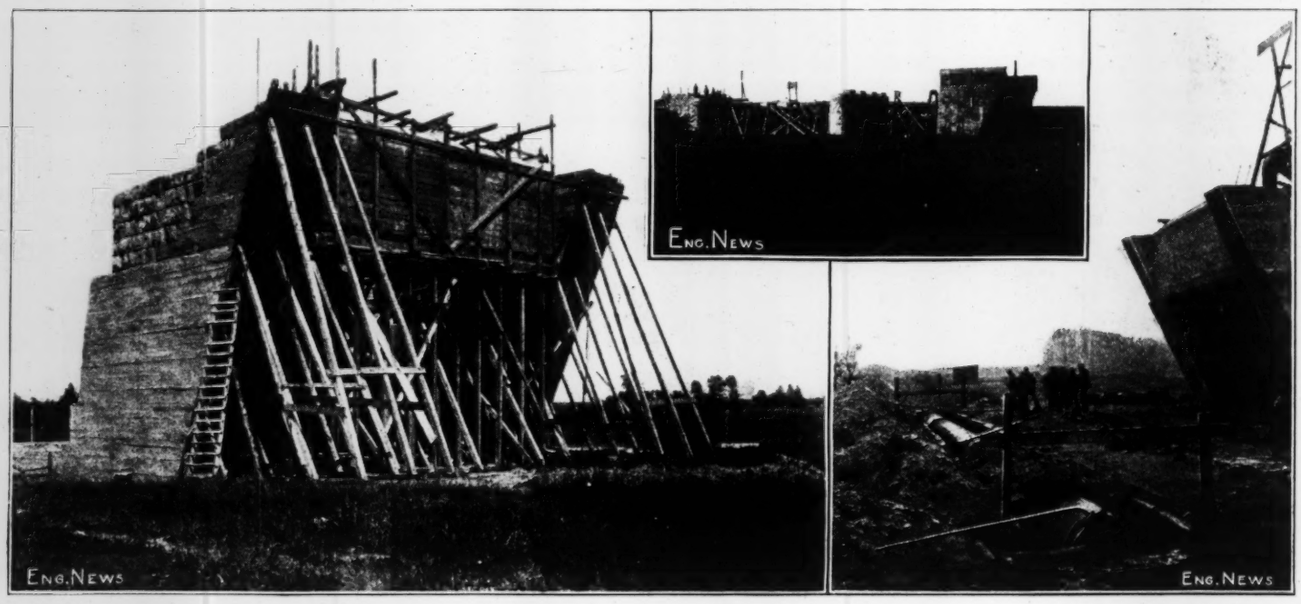



FIG. 2. BOTTOM FORMS STILL IN PLACE

FIG. 3. BACK OF ABUTMENT PIER

BRIDGE-ABUTMENT PIER ON DATTELN-HAMM CANAL, GERMANY

wedging action of the earth is avoided. Even without this, the outward pressure from earth load and surcharge is such as to require a very considerable cross-section for the transverse tie. The use of reinforced concrete for this member will be seen to make a substantial construction and obviate all rusting trouble. The top surface of the tie is shaped to a ridge, minimizing the earth pressure on it.

The views show several abutments of this type during construction and after completion. They clearly exhibit the peculiar shape of the abutment and also show how the forms for the concrete work had to be supported under the overhang of the wings.

The exterior or showing faces of these abutments are in general of sandstone, the body being in all cases of concrete. The bridge seats are separately molded reinforced-concrete blocks. Oberbaurat Hermann, of the Königliche Kanalbaudirektion, Essen on Ruhr, is in charge of the canal section to which the illustrations and description pertain.

# Expediting Progress on "Rush" Construction Work*

BY JAMES L. STUART†

In May, 1910, a large manufacturing plant at Pittsburgh, covering approximately 15 acres, was almost totally destroyed by fire. All of the buildings were brick, some with wood trusses and slate roofs, but the greater number were constructed with steel frames and cement tile roofs. The fire in and around these steel structures was so intense that most of them collapsed of their own weight and were but a mass of twisted steel, broken cement tile, brick and mortar, all of which it became necessary to remove in order to reconstruct the plant.

We first received orders to clear the site and subsequently were instructed to proceed with the reconstruction of the buildings. Fortunately, the power plant had not been greatly damaged and we were able to get sufficient current to use in cutting up or burning apart the collapsed steel frames. This steel wreckage was so badly damaged that it was loaded on cars and sold as junk.

After the site was cleared we began excavating for the new foundations, starting on the buildings that would be required first and those in which the greatest amount of machinery was to be installed. This scheme was followed so as to enable the entire plant to be completed at about the same time. It was the desire of the company to commence manufacturing by October, or earlier if possible. The key to this particular situation was to get the steel, of which there was about 4800 tons.

After consultation with the operating and executive departments of the company, the order in which the different buildings were to be completed was decided on. Dates were fixed for the delivery of the steel for each building and were included in the schedule for the completed buildings. The structures were quite simple, similar to most modern factory buildings, but in order to live up to our schedule we knew we must keep continually in touch with the bridge company and see that nothing was permitted to lag or be left undone in order to make the deliveries as they promised.

Our expediter was put in charge of the job at once and during the first month spent most of his time between the order department of the bridge company and the steel mills at which the plain material was being rolled. After the last of the orders for the plain material had been sent to the rolling mills he devoted his time more particularly to the drawing room of the bridge company and reported daily what

*Abstract of a paper in the September number of the "Journal" of the Cleveland Engineering Society.

†Consulting Engineer, Pittsburgh, Penn.

progress was being made in designing, detailing and checking, the number of draftsmen employed, and the progress made on each building.

At times it was found that the checking department was overbalanced by the detailing department, and that the designing department was not turning out sufficient work to keep the draftsmen doing the detailing and the checkers busy. This was adjusted by numerous meetings between the bridge company, the executive department, the manufacturing company and ourselves.

The principal requisites of an expediter are, a thorough knowledge of the work to be performed, a pleasant personality, and the ability to interest the people who are actually doing the work (in this case, the men who made out the mill orders, the draftsmen, the different foremen in charge of the rolling mill and the foremen in the fabricating shop). All should be made to feel that their interests are parallel and that what is good for one is good for all.

As soon as the drawings for one of the buildings were completed, we saw that this work was put in the shop at once, where someone had already seen that the plain material was delivered, and that no time was lost in fabricating and shipping.

At times during the preparation of the drawings it was found necessary to urge the bridge company to employ additional men in all departments. This required considerable tact and force as, naturally, the heads of the different departments do not care to have their routine changed or, as they express it, "meddled with." This phase of the difficulty can be overcome only when it is possible to get sufficient interest aroused in that particular piece of work.

When the work was started, our expediter received from the rolling mills a list of their daily rollings, and we saw to it that certain materials were got in on the dates at which the first rolling of that particular material was made. This saved not a little time and we were able to get all of the plain material delivered before the shop drawings were entirely completed on the first building.

The meetings between the heads of our department and the heads of the bridge company were most useful. Our expediter was usually on hand and we were able to discuss the progress made since the last meeting, the condition of the work in the drafting room and shop, and to devise ways and means for overcoming any obstacles that had arisen either due to lack of men or want of materials.

The steel was erected as fast as the work was got out of the mill, fabricated and delivered. We insisted on its being fabricated in sequence, so that any materials delivered at the building could be immediately put in place. It had been previously decided at which end of the building the work would commence and our superintendent in the field was advised of this fact and was also kept in thorough touch with the progress of the different stages of the steel.

As the cars of steel were loaded and shipped out, they were put in the hands of the tracing department of the manufacturing company and our own tracing department, and shipments were followed up until they were finally landed at the site. Our tracing department had, prior to this time, made the acquaintance of the different employees of the railway through whom the records of the movement of the cars was to pass, as well as those who had direct charge at the transfer points.

After the steel had been delivered the rest of the work was a mere question of brick, mortar, sand, gravel, cement, window frames, sash, roofing material and sufficient workmen. Of course, there were large quantities of all these materials required and in order not to delay the work it was imperative that certain amounts be delivered and put in place prior to the delivery of the steel.

This same method was applied to the construction of the Statler Hotel, at Cleveland, except that the work was much more complicated and required many more details. There were approximately 90 sub-contractors and material men in and around the building from almost the day it was started until its completion, and it required a great deal of patience, perseverance and hard work to get the different trades to dovetail into each other throughout so that those who did the preparatory work would be through and away in time to permit the finish material to be erected.

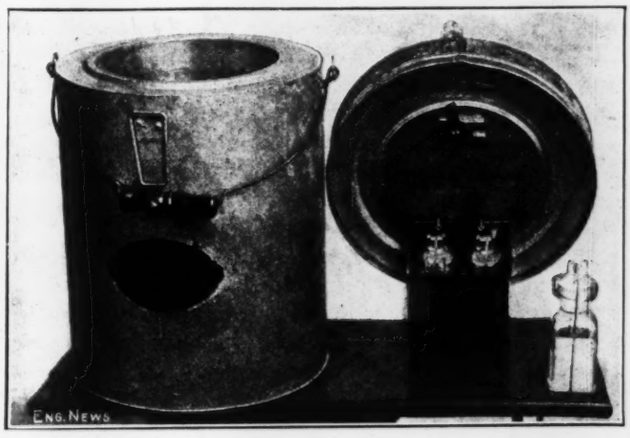
We found it necessary to insist on daily meetings of all of the sub-contractors on the work, together with the architect's representative and others interested in the building. At these daily meetings each trade was taken up separately with the principal representative of that particular trade and the representatives of all the other trades present. He was asked regarding the progress of his work and was told to state whether or not he was being retarded by any of the other trades. If it was found that he was being hampered he was made to state explicitly and in detail to what extent and how.

# A New Shipping Outfit for Iced-Water Samples

In shipping water samples for bacterial analysis it is necessary that the water be kept at so low a temperature as to inhibit bacterial growth and also that the bottles containing the samples be protected against breakage. In other words, a combined refrigerator and packing case must be provided, and obviously the weight and bulk must be kept down for convenience in handling and to save transportation charges.

To meet the demands just specified under conditions of long shipping distances and high summer temperatures a shipping outfit has been devised by the Kansas State Water Survey Laboratory which satisfactorily stood the test of the very hot summer of 1913.*

The following description of these outfits, of which 50 are now in use, will be more readily understood by reference to the accompanying view which shows the various parts.




SHIPPING OUTFIT FOR WATER SAMPLES

SAMPLE BOTTLES—Square sample bottles of 6-oz. holding capacity are used. These are further described in the paper as follows:

One face is ground so that the description of the sample can be written on the bottle. The top of the ground space serves as a graduation for 4 oz. of water, thus allowing for an air space above the sample. The stoppers and bottles are numbered and each stopper is ground to fit.

The special feature of this bottle is the design of the stopper. The stopper proper is partially protected by an overhanging hood. The hood, however, has for its chief purpose the protection of the neck of the bottle. The handle is notched to hold a strong rubber band and is heavy enough so that if the stopper is laid down, the portions coming in contact with the water will be held away from the surface on which the stopper is placed.

Twelve dozen of these bottles have been in use three months. In that time only six have been broken in sterilizing, two in shipment and four in collecting samples. In practice the bottles are washed with chromic-acid cleaning mixture, rinsed, dried, and then sterilized in a dry oven at 180° to 200° C. for an hour.

BOX FOR HOLDING SAMPLE BOTTLES—The bottles are placed in a copper container, rectangular in plan, provided with a movable partition so that either 1, 2, 3 or 4 bottles can be carried.

*Based on a paper describing the outfit read on Sept. 11, 1913, before the Laboratory Section of the American Public Health Association, at Colorado Springs, Colo., by Frederick H. Billings, professor of bacteriology, and C. C. Young, director State Water Survey, University of Kansas, Lawrence, Kan. The paper will be published in the "Journal" of the Association.

Refrigerator Case—For holding ice and insulating and protecting the container and its samples a case of pressed ground cork, molded in one piece, protected on the outside with No. 28 galvanized iron and on the inside with 8-oz. tinned copper, seamed and soldered, is used, the whole provided with a clamped cover and a bail to make a handy shipping case. This refrigerator is 12 in. in diameter and 16 in. high, outside, 8 in. in diameter and 12 in. deep, inside, and weighs 17 lb. when empty. Packed for shipment with four samples in their copper box, and with ice, the outfit weighs 24 lb., thus coming under the 30c. limit of "express tariff K."

The copper box containing the bottles is hung from the lid of the refrigerator by two hooks and a catch, which brings the box snug up to the under side of the lid and leaves space below the copper box, in the refrigerator case, for 6 or 7 lb. of ice. Once the catch is closed and the lid fastened in place, it is impossible for the catch to come unfastened until the lid is removed.

Should the whole outfit be tipped over during shipment the arrangement described prevents the melted ice from coming in contact with the sample bottles.

It was found on trial in a 37° C. incubator that 6 lb. of ice would keep water samples placed in this refrigerator below 10° for 34 to 36 hours, "depending upon the size of the pieces of ice used in packing."

Results—Of about fifty shipments to the laboratory by the state sanitary engineer and members of the Survey staff, all arrived with the samples below 10° C. Of 104 shipments by county health officers, city engineers and water-works superintendents, most of these men never having used the outfit before, all but ten outfits reached the laboratory with samples below 10° C., 60 still contained some of the ice used in the original packing and of 34 without ice all were under 10° C. Of the ten outfits received in poor condition 8 were en route 48 hr. or more and two, which were on the road only 36 hr., showed, by the amount of water in the ice space, that they had not been properly packed.

A table showing for the 104 shipments the distance shipped, transfers en route, hours en route, maximum temperature at Lawrence and condition on arrival seems to bear out the conclusion of the authors that "when properly iced this container will keep samples under 10° [C.] for 36 hr. in the hottest weather."

All but some thirty of the shipments were from distances of more than 100 miles and nearly thirty were from distances of more than 200 miles. More than 50 of the shipments were received at Lawrence on days when the thermometer registered a maximum of from 100 to 105° F. and about 80 shipments came in under maximum temperatures of more than 90° F.

The shipping cases were made by the 3-H. Mfg. Co., Lawrence, Kan., and the bottles were supplied by Bausch & Lomb, Rochester, N. Y.

## Rules for Laying Up Idle Equipment

Machinery used on the Panama Canal, which is now being retired from service, is to be handled according to rules published in an official circular dated Sept. 12 and published in the *Canal Record* Sept. 24. We reprint the rules below, as they are just as useful for general contract equipment as for the Panama Canal machinery.

**Locomotives**—Boilers should be emptied and thoroughly cleaned of all scale and foreign matter. Boiler should then be filled with water, leaving space enough for at least two barrels of crude oil or a sufficient amount of crude oil to cover the internal surfaces of boiler and tubes. This oil should be put in at dome, then blow-off cock should be opened up and boiler drained. The same instructions apply to locomotive tanks as to boilers. The front end of locomotives and fireboxes of all boilers should be thoroughly cleaned and brushed off with wire brush and given a coat of tar paint. This paint can be put on with a spray. The coal space on all locomotive tanks should be thoroughly cleaned and scaled and surface given a coat of tar paint. All exterior surfaces of equipment should be painted if necessary, using the standard grade of paint which is commonly used for that purpose. The jackets on all boilers should be given a coat of white lead and tallow. Smoke stacks should be covered with sheet-iron covering made specially for this purpose. Main rods of locomotives should be disconnected and all bearing and bright surfaces receive a coat of white lead and tallow. Eccentric straps and blades should be removed from locomotives and placed with main rods in the cabs, and cabs boarded up. The steam chest cover should be lifted, cylinder heads removed, and all surfaces treated with a coating of white lead and tallow. It will be necessary to remove the valves and pull pistons in order to get at the parts, which should be replaced, steam chest and cylinders closed, and the crossheads blocked in order to eliminate the moving of the pistons in cylinders. The air pumps and the feed pumps on all equipment should be opened up and surfaces treated with a coat of white lead and tallow. The cap on engineer's brake valve on locomotives should be lifted and the surfaces of the valves, etc., slushed with vaseline. All exterior surfaces of cab fittings should be given either a coat of white lead and tallow or vaseline. Interior surfaces of triple valves and injectors need not be treated, as they are brass. Journal box cellars on all drivers and engine truck wheels should be well packed, also journal boxes on tanks.

**Steamshovels**—The same general rules for the care of locomotives will apply to steamshovels. All engine pistons, valves, rods, eccentric straps, "A" frame collar and swing circle to be removed; shafts lifted from bearings, wearing surfaces cleaned, doped with white lead and replaced. Boilers should be stripped with lagging, and cleaned as outlined for locomotive boilers. Water tanks should be taken off shovels, inspected, and if found in bad condition they should be scrapped. Roofs should be painted with tar paint; also coal platforms and dippers. Other parts now covered with oil or grease can be protected with a coat of crude oil, which will be sufficient protection.

**Unloaders, Cranes, Spreaders, Hoisting Engines, Track-shifters and Piledrivers**—Machinery should be gone over and given a coat of white lead and tallow, as outlined for steam-shovels.

**Miscellaneous Machinery, including Shop's Machinery and Tools**—Air pumps and feed pumps on all equipment should be opened up and surfaces treated with a coating of white lead and tallow. All bearings, journals and bright surfaces of all machinery and equipment should be given a coat of white lead and tallow.

## Intersecting Circular Curves with Non-Parallel Tangents: A Theorem

By W. R. Horn*

An article on "A Special Problem in Reverse Curves," by Wm. C. Crosby, appeared in Engineering News of June 26, 1913 (p. 1322). It may interest the writer of that article and perhaps some others to know that the construction there shown is a particular case of a more general geometrical theorem which is applicable to a wide range of problems involving circular curves.

Theorem—If $AC$ and $BC$, Fig. 1, be two given straight lines intersecting at an angle $\delta$, and arcs of circles $AP$, $BP$ be drawn touching these lines at $A$ and $B$, and intersecting in $P$ at an angle $\alpha$, then

$$Angle\ A\,P\,B = \tfrac{1}{2}\,(\alpha + \delta)$$

and therefore the locus of point $P$ for all arcs intersect-

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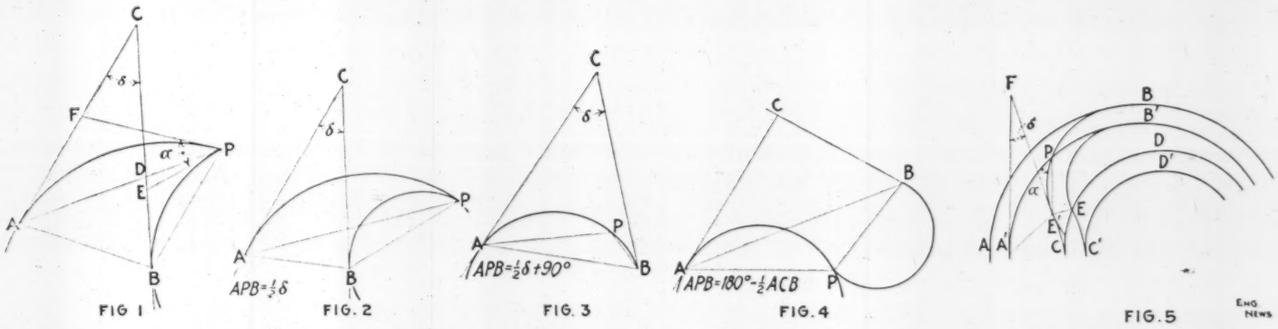
ing at the same angle $\alpha$ is a circle passing through $A$ and $B$, whose radius is $\frac{AB}{2 \sin \frac{1}{2}(\alpha + \delta)}$.

A particular case of this theorem in which the center of the arc $BP$ lies on $AB$ produced, is given in a paper by Preston & Barnard in "Proceedings of the Institution of Civil Engineers," Vol. CXLV, in which it is applied to the theory of railway turnouts laid with curves tangential to the switches. I may add that the general theorem suggested itself to me after a perusal of this paper.




Proof—In Fig. 1, $BE$ and $PE$ are tangents to the arc $BP$; $AF$ and $PF$ are tangents to the arc $AP$. The angle $EPF$ is $\alpha$, the angle of intersection of the arcs. In the triangles $ACD + DPB$, $\angle$s $ADC$ and $BDP$ are equal. Hence,

$$\angle ACD + \angle CAD = \angle DPB + \angle DBP$$

But since $AF$ and $PF$ are tangents to the arc $AP$,

$$\angle CAD = \angle FPA$$

Similarly,

$$\angle DBP = \angle EPB$$

Therefore we have

$$\delta + \angle FPA = \angle APB + \angle EPB$$

that is

$$\delta + FPB - APB = APB + EPB$$

Therefore,

$$2 \angle APB = \delta + FPB - EPB = \delta + \alpha$$

$$APB = \tfrac{1}{2}(\alpha + \delta)$$

which proves the proposition.

Special Cases—The theorem will hold whatever may be the value of the angle $\alpha$, and will therefore hold when the two arcs are tangent. In Figs. 2 and 3, two such cases are shown; in Fig. 2, $\alpha$ = zero, while in Fig. 3, $\alpha$ = two right angles.

The case given by Mr. Crosby is shown in Fig. 4. In this case since the curves are reverse, the angle $\delta$ must be taken as the supplement of the angle $ACB$, that is as $180° - ACB$, and $\alpha = 180°$. The angle $APB$ will, therefore, be $\frac{1}{2}(360° - ACB)$, that is, $180° - \frac{1}{2} ACB$. In all these cases (Figs. 2, 3 and 4), it is clear that the center of the circular locus of $P$ lies on the circumference of the circle circumscribing the $\triangle$ $ABC$.

The importance of the theorem in the theory of railway turnouts is well shown in the paper (referred to above) of Preston & Barnard, and I shall conclude by showing how it is to be applied to the general case of a crossover, which case was not treated by them.

Application to a Crossover—In Fig. 5, let $AB$, $A'B'$ and $CD$, $C'D'$, be any two curved tracks (which need not be, and are therefore not shown as concentric), and suppose it is desired to connect these tracks by a crossover with frog angles $\beta$ on $CD$ and $\alpha$ on $A'B'$. Let $E$ be the position of the frog on $CD$, and let $E'$ be the point on the other rail of the turnout, directly opposite to $E$. Let $E'F$ be the tangent at $E'$ to the curve $CE'$. The problem then is: to find the position $P$ on the rail $A'B'$ of a frog of angle $\alpha$, such that a circular curve may lie evenly between it and the tangent $E'F$.

Take any point $A'$ on the rail $A'B'$, and let $A'F$ be the tangent at $A'$. Measure the angle $A'FE'$, and call it $\delta$. Then by the theorem, the position of the crossing $P$ will be at the intersection of the rail $A'B'$ with the circumference of a circle of radius $\frac{\frac{1}{2} A'E'}{\sin \frac{1}{2}(\alpha + \delta)}$, described to pass through $A' + E'$. Having thus found the position of $P$, the crossover may be run by the ordinary methods.

This will, of course, afford a solution of the case of a crossover between two parallel curved tracks, dealt with in an article by R. W. Stewart in Engineering News of May 22, 1913, (p. 1068).

## Templates for Embankment Slopes

By M. D. Ewell*

During the building of and repairs on a dike along the Oswego River, I worked out and used the following devices in locating embankment lines. I found these homemade instruments to be sufficiently accurate and a great saving of time.

Fig. 1 illustrates the template used in building the slope originally. It was made from 1x2-in. pine strips nailed in the form shown. The hypotenuse or grading side was about 8 ft. long, and when in use was located in the proper position by setting the base of the templet on on the top of the slope stake, which had been previously set in the usual manner except that the top of the stake instead of the base intersected the slope. The proper slope for the template was shown by means of a plumb line attached to the upper brace, falling across a mark on the lower one. This instrument was placed in the hands of the inspector and used by him from time to time to check the outline of the embankment. When the bank was built up to nearly the limit of the template a new stake was set under the upper end, and the template raised to this position.

After some time it was found, in this particular case, that the slope had been built too steep to stand properly.

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and it was decided to make repairs by narrowing the top and flattening the slope. For this work I devised the template shown in Fig. 2; it was made of strips as before, in the form of a truss 16 ft. between supports. Each support was made adjustable in length, by means of clamps at *A* and *B*, and graduated in feet and tenths from zero to 4 ft., from the bottom up. The lower chord was also graduated in feet and tenths from zero to 16 ft. In use the stake at *E* was set with its top on the line and grade of the shoulder of the embankment. The template was then placed in the position shown, with the uphill leg on the top of the stake *E*. Clamp *A* was then set so that *AE* equaled 2 ft. The lower chord was then brought parallel to the finished slope as indicated by a plumb line supported at *F*, falling across a mark on the lower chord. The template was held in this position by the lower leg and clamp at *B*. In this position sections for final estimate were taken with a small rod held normal to the lower chord, distances being read directly on the lower chord. A rod

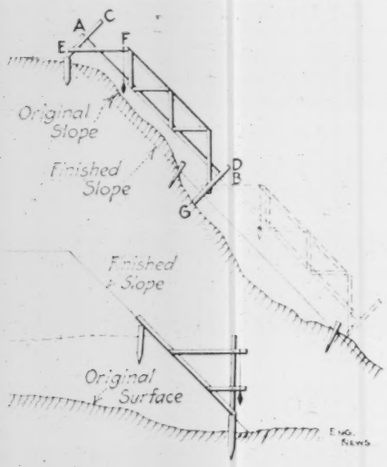



FIG. 2. (ABOVE) TEMPLATE FOR TRIMMING BANK
FIG. 1. (BELOW) TEMPLATE FOR BUILDING BANK

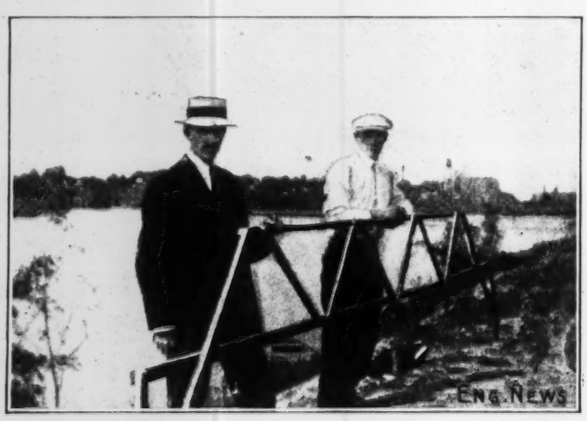


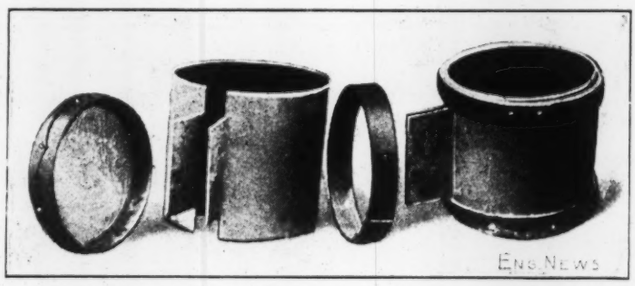

FIG. 3. TEMPLATES FOR SETTING TRIMMING STAKES ON EMBANKMENT SLOPES, OSWEGO CANAL

of less than 2 ft. indicated *Cut*; of just 2 ft., the position for a slope stake; of more than 2 ft., *Fill*. The template was then moved down the hill until the upper leg stood in the same position and at the same reading the lower one previously stood. The process was then repeated as many times as necessary to reach the bottom of the slope.

## NOTES

**A Mold for Field Samples of Concrete,** designed by C. V. Mann while engineer in charge on the Albion masonry dam for Boulder, Colo., is shown in the small view herewith. It proved very convenient and useful for taking samples, both those intended for crushing in the testing machine and those wanted for record samples and the like. Samples were taken as the concrete came from the mixer to go into the dam, and most of them were later broken with a hammer for examination of structure, toughness, etc.

The mold is made of No. 18 galvanized iron. The cylinder is split and has outward-projecting lug portions at the joint,




MOLD FOR FIELD SAMPLES OF CONCRETE, 6x6-IN. CYLINDERS
(Used by C. V. Mann on Albion Dam.)

which are a help in slipping on the top and bottom rings of the mold and further serve to make a tight joint up the side. The top and bottom rings (the latter having the mold bottom riveted to it) are of 1x⅛-in. iron. Both rings slip over the mold cylinder, fitting it snugly, and are readily knocked off when the sample has set by tapping with a hammer. The mold is 6 in. in diameter and 6 in. long.

**Breaking Quarry Stone with a Cannon Ball**—In breaking up masses of blasted rock at a quarry for use in the cyclopean masonry of the Farnham dam of the additional water-supply system of Pittsfield, Mass., the contractor, MacArthur Bros. & Winston, rigged up the device illustrated in the accompanying photograph. The ball was of cast iron and weighed about 3000 lb. A jerk of a cord released it from a

hook attached by wire rope to the derrick-boom. The rapidity and efficiency of its operation evidently depends largely on the operator and the circumstances, but we have been informed that these contractors have made use of the device on several occasions. [Photograph and data from Hiram Allen Miller, Consulting Engineer, Boston, Mass., under whose supervision the new water-works were constructed.]

**The Graphical Method of Dividing the Neutral Axis** in concrete arch design described in an article by T. A. Smith in our issue of September 25, 1913, p. 611, is also to be found in the chapter on arches by Prof. Frank T. McKibben in

Taylor & Thompson's "A Treatise on Concrete, Plain and Reinforced," p. 554. That the method had previously appeared in the literature of the subject escaped the memory of the editor in preparing Mr. Smith's article.

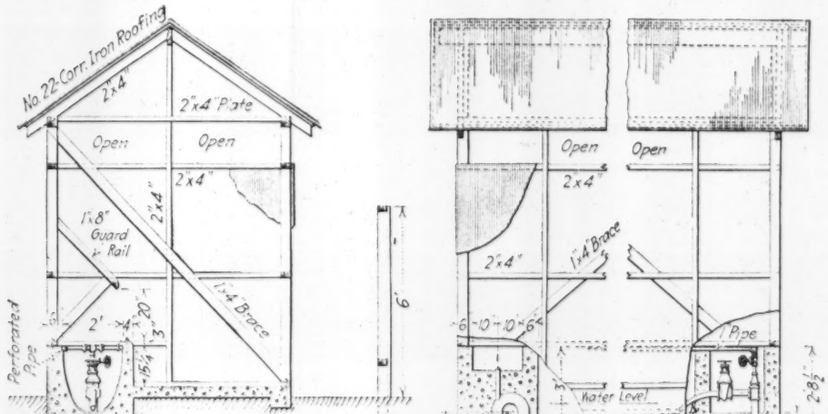
**Fountain Drawing Pen**—Our mention of a fountain drawing pen (Sept. 25, 1913, p. 614) leads Virgil A. Eberly, New Orleans, to tell of two years' favorable experience with another fountain drawing pen, a Riefler pen bought at Culebra, Canal Zone. He says:

I am certainly surprised that your draftsmen do not know of it and use it. The application of the ink is by screwing the piston into the hollow handle or barrel, which forces the ink through a tube between the nibs. The size of the tube is large enough to insert a ramrod (furnished with the pen) to clean out any dried ink. The pen thus does not depend on natural flow, which is always uncertain with a quickly drying ink. Besides, the amount of ink between the nibs can be varied to any desired quantity at will. I would consider a draftsman somewhat slow who does not know of Riefler's pen. I paid only $1.25 or $1.50 for this pen, as I did not have to pay any duty.

We understand that the American price of similar pens is $3 or $3.50.

**Cost Data on Blueprinting**—Referring to an article on this subject in our issue of Sept. 25, p. 612, we are informed by the manufacturers of the blueprinting machine mentioned, the Revolute Machine Co., New York, that two of the expense figures charged to the machine are in error: The cost of replacing the lamps (stated in the article as $16) should be $32; the cost of a new glass cylinder (stated as $75) should be $65.

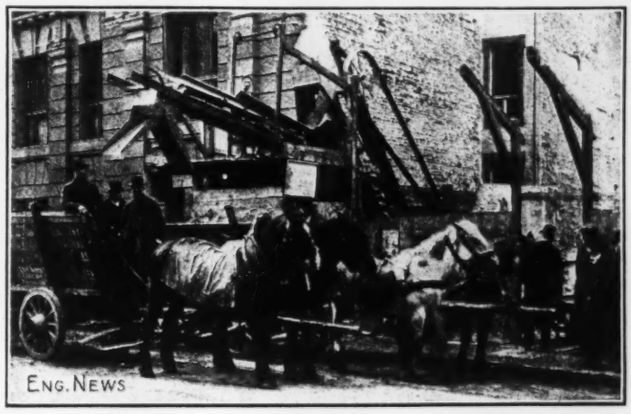
**A Simple Latrine** has been designed for the new smelter plant of the United Verde Copper Co., at Clarkdale, Ariz. Its two distinguishing features are (1) the use of concrete for the trough and floor of the latrine and (2) a light wood frame covered with corrugated sheet iron for the building with the sides of the building open just below the eaves, all




LATRINE FOR UNITED VERDE COPPER CO., CLARKDALE, ARIZ.

as shown by the accompanying sections. The latrine is about 8x20 ft. in plan, and, like the smelting plant as a whole, was designed by Repath & McGregor. The front wall of the latrine is surmounted by a 2x6-in. plank, rounded and polished, fastened to the concrete by ½-in. hook bolts. Almost directly over this seat and 20 in. higher is a back rest, which at the same time serves to guard against improper use of the seat. Water is constantly kept in the bottom of the trough, the desired ordinary water level being maintained by the lead trap shown in the longitudinal section. The water-supply to the trough is controlled by a valve. The sides of the trough are kept wet and clean by continuous sprays from perforated 1-in. pipe extending along the top of either side of the trough. The latrine will discharge into the general sewerage system, the sewage from which will go to a septic tank. We are indebted to "The Engineering and Mining Journal" for the original from which our illustration was prepared as well as for the text on which this note is based. We may add that both the latrine proper and the building which covers it are better suited to an Arizona climate than to one very much colder, and that the open sides just beneath the eaves would not be tolerable where heavy wind-driven rains may come almost any day.

**Handling Cellar Excavation with a Conveyor**—Improved methods in excavating were practised in preparing the site for an addition to the buildings of the Deutsche Bank, Berlin, Germany. This site is on the west side of Mauer St. opposite the two buildings now occupied by the bank. A bucket conveyor was set up on one side of the site, extending from




HANDLING FOUNDATION EXCAVATION WITH A CONVEYOR, BERLIN, GERMANY

near the rear of the lot to a belt conveyor on the sidewalk at the front. The dirt was shoveled directly to this conveyor and the material was discharged from the apron at the street directly into wagons. The arrangement at the street can be seen in the adjoining view. The apron or chute is double, so that either or both of two wagons can be filled. The general contract for the building is held by Boswau & Knauer, but the excavation was sublet to the Metropol Ausschachtgesellschaft, who have patents on the conveyor machinery and make a separate business of excavation.

❖

# A Shear and Rivet Diagram for Railway Plate-Girders

In detailing plate-girders, shear calculations and determination of flange-rivet spacing are facilitated by the diagram reproduced below. It was made by Joseph Jacobs, Seattle, Wash., 11 years ago.* This diagram, together with one connecting flange area, depth and span, covers practically all main calculations required for railway plate-girders.

The diagram shown was computed for the Southern Pacific Co. specifications of July 1, 1900. These limit rivet bearing to 16,000 lb. per sq.in. on projected surface. Shear is limited to 9000 lb. per sq.in., but does not enter into the diagram, as bearing has been assumed to govern. For shallow, thick girder-webs, double shear may govern, and such cases must be computed independently.

A diagram like this can be constructed for any other loading (changing only the shear curves, at the right), or for any other value of bearing unit-stress (changing only the rivet-spacing scales).

*A diagram somewhat similar to that by G. D. Fish was published in our issue of Apr. 24, 1913. Mr. Jacobs' diagram is handier for shear and rivet computations, besides being ten years older.

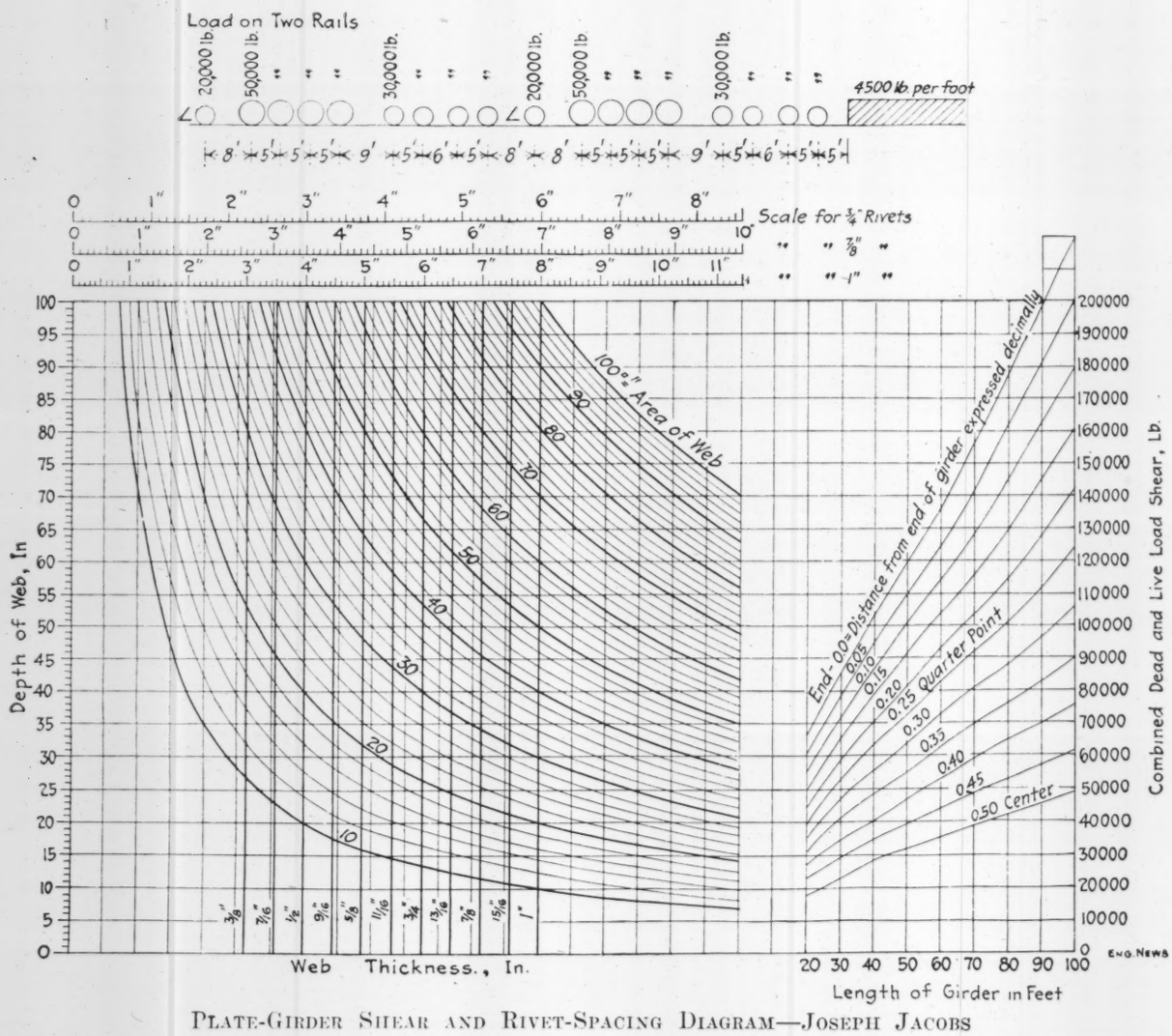



PLATE-GIRDER SHEAR AND RIVET-SPACING DIAGRAM—JOSEPH JACOBS

**Loading: Southern Pacific Co.** Loading of 1900 specifications; nearly equivalent to Cooper's E-50 loading.

**Stresses:** Rivet shear 9000 lb. per sq.in.
Rivet bearing, 16,000 lb. per sq.in.
(Rivet spacing based on bearing.)

1. **Vertical Shear**—Curves at right give total **dead plus live shear** at any point along the girder, for girders 20 to 100 ft. in span.
2. **Area of Web**—Hyperbolic curves at left give area of web, for given thickness (read below) and depth (read at left).
3. **Flange Rivet Spacing**—To find the rivet spacing at a given point of the girder: Read the shear from curves at right. Depth and thickness of web being known, locate the curve of area of web (as in 2, using depth between rivet rows), and follow along this curve to the horizontal denoting the shear, as just found. Vertically above this intersection read on upper scale the required rivet spacing.
4. **Limiting Position of Any Rivet Pitch**—Locate curve of web area (using depth between rivet rows). Follow along this curve to intersection with vertical denoting the given rivet pitch. From here follow horizontally to the shear diagram, and intersect the vertical denoting span. The inclined curve at this intersection denotes the position along the girder where the given spacing reaches its limit.
5. **Web Thickness for Minimum Rivet-Pitch**—Intersect the vertical denoting minimum permissible rivet pitch with the horizontal denoting **end shear;** the area curve at this intersection, followed to the horizontal denoting **depth between rivet rows** gives the vertical denoting the required web thickness.

   Where the maximum web thickness is limited, the procedure (5) can be used to find minimum depth of web.

NOTE: The diagram gives theoretical limiting values. Details of construction, shop practice, etc., may require these values to be modified.

# Equivalent Uniform Loads on Bridges for Different Types of Engine

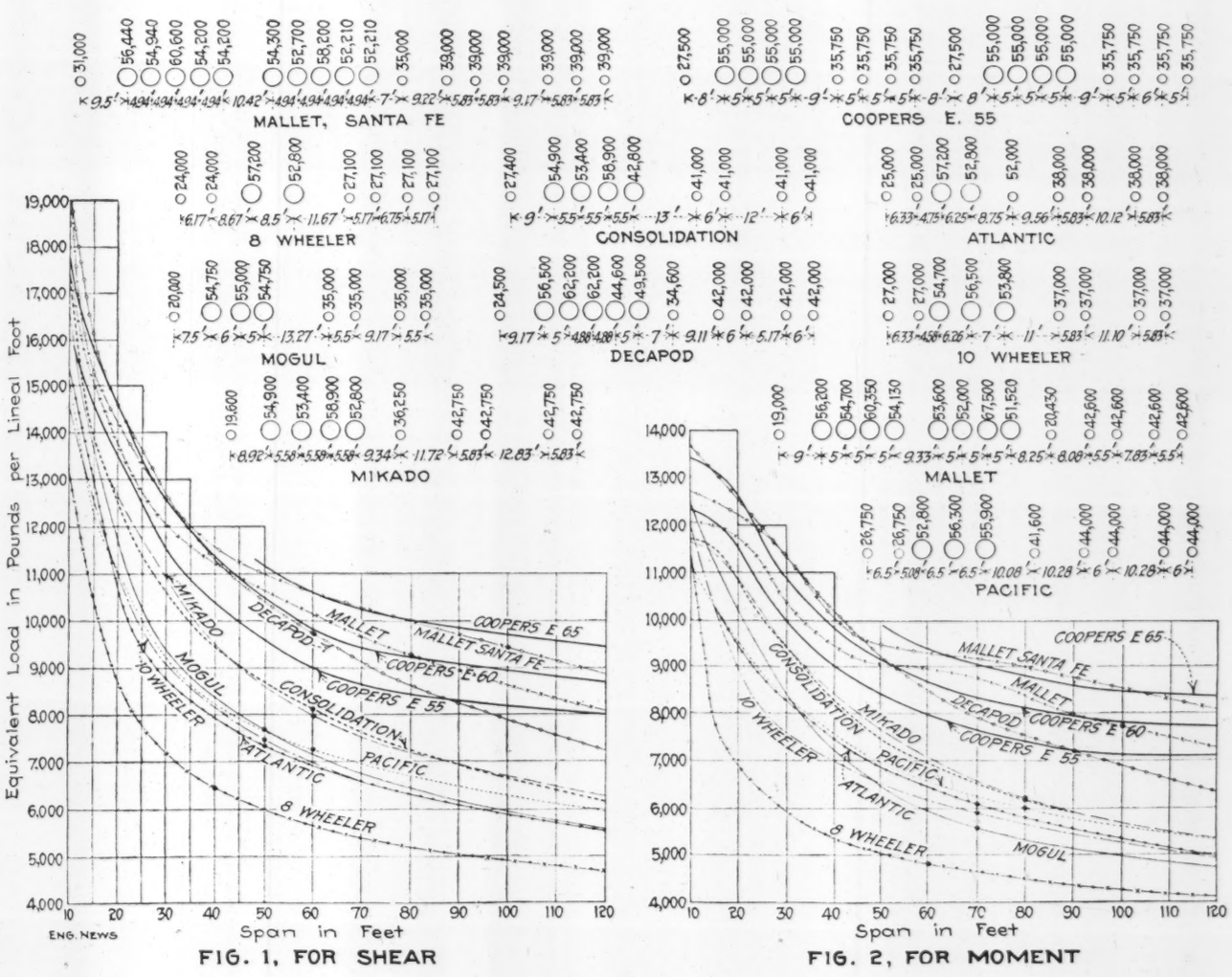
In bridge designing, the conventionalized wheel-loads known as Cooper's loadings are used very extensively, though heavy types of locomotive differ materially from the Cooper arrangement. The designer, therefore, must know how various engines in common use compare, in regard to stresses produced. This information is given in very useful form by three diagrams prepared by C. D. Purdon, Chief Engineer, St. Louis Southwestern Ry. Co., St. Louis, Mo.

The diagrams Figs. 1 and 2 are drawn with span lengths as abscissas, and equivalent uniform loads as ordinates. Ten actual engines and three Cooper loadings (E55, E60, E65) are represented, each by a curve. Fig. 1 is based on end shear; Fig. 2 on bending moment.

To prepare these curves, engines of various types were selected, on the basis of 55,000-lb. *average driving-axle load.* The train-loading behind the engine was taken as 5500 lb. per lin.ft. track (one-tenth the average driving-axle load), so that the basis of both engine and train selection would correspond to Cooper's E55 loading.

The wheel-diagrams of the various engines used are sketched above the diagrams.

The two diagrams are summarized in Fig. 3, where the ordinates are the Cooper equivalents, abscissas again being lengths of span. Since the Cooper loading which corresponds to a given engine loading at a particular span length is different for moment and for shear, the two values were taken from Fig. 1 and Fig. 2, and the higher one used for Fig. 3.




FIGS. 1 AND 2. EQUIVALENT UNIFORM LOADS FOR SHEAR AND MOMENT, 10 ENGINES OF 55,000-LB. BASE AND THREE COOPER LOADINGS

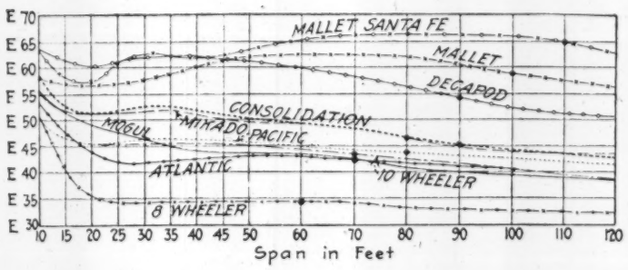



FIG. 3. COOPER EQUIVALENTS OF 10 ENGINES OF 55,000-LB. BASE

## A Convenient Earthwork Table

BY PHILIP B. HILL*

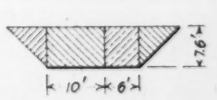
A great many earthwork tables have been published, but a careful search has failed to reveal a table just like the one accompanying this article. The table and the figures illustrating its use are self-explanatory. By means of the table the yardage for level cuts and fills may be obtained very quickly.

*Of Lund & Hill, Consulting Engineers, Little Rock, Ark.

The quantities have been carried out to 100ths in order that the quantities may be estimated closer than the nearest cu.yd. if so desired. Most tables of this character give quantities to the nearest cu.yd. only. [The part of the table 1 to 1.9 ft. has been omitted for want of space, but the quantities may be quickly supplied by taking one-half the corresponding quantities for 2 to 3 ft. in the "width of base" column and ¼ the quantities in the "slopes" column.]

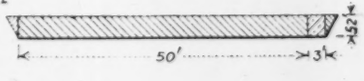
16' BASE, 1:1 SLOPES, 7.6' CUT OR FILL

| | | |
|---|---|---|
| 10' PRISM CONTAINS | | 281.5 CU. YD. |
| 6' " " | | 168.9 " " |
| SLOPES " | | 213.9 " " |
| | TOTAL | 664.3 " " |



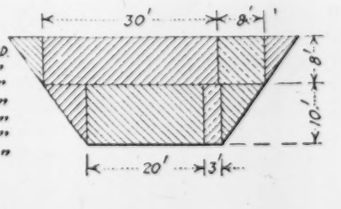

53' BASE, ½:1 SLOPES, 5.2' CUT OR FILL

| | | |
|---|---|---|
| 50' PRISM CONTAINS | | 963.0 CU. YD. |
| 3' " " | | 57.8 " " |
| SLOPES " | | 50.1 " " |
| | TOTAL | 1070.9 " " |




23' BASE, ¾:1 SLOPES, 18' CUT OR FILL

| | | |
|---|---|---|
| 20' PRISM, 10' DEEP CONTAINS | | 740.7 CU. YD. |
| 3' " " " " | | 111.1 " " |
| SLOPES " " " | | 277.8 " " |
| 30' PRISM 8' " " | | 888.9 " " |
| 8' " " " " | | 237.0 " " |
| SLOPES " " " | | 177.8 " " |
| | TOTAL | 2433.3 " " |



## EARTHWORK TABLE—CUBIC YARDS PER 100 FEET, LEVEL SURFACE

| Depth of cut or height of fill | Width of base or crown 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Slopes ½ : 1 | ¾ : 1 | 1 : 1 | 1½ : 1 | 2 : 1 | 3 : 1 | Depth of cut or height of fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 0 | 7 41 | 14 81 | 22 22 | 29 63 | 37 04 | 44 44 | 51 85 | 59 26 | 66 67 | 7 41 | 11 11 | 14 81 | 22 22 | 29 63 | 44 44 | 2 0 |
| 2 1 | 7 78 | 15 56 | 23 33 | 31 11 | 38 89 | 46 67 | 54 44 | 62 22 | 70 00 | 8 17 | 12 25 | 16 33 | 24 50 | 32 67 | 49 00 | 2 1 |
| 2 2 | 8 15 | 16 30 | 24 44 | 32 59 | 40 74 | 48 89 | 57 04 | 65 19 | 73 33 | 8 96 | 13 44 | 17 93 | 26 89 | 35 85 | 53 78 | 2 2 |
| 2 3 | 8 52 | 17 04 | 25 56 | 34 07 | 42 59 | 51 11 | 59 63 | 68 15 | 76 67 | 9 79 | 14 69 | 19 59 | 29 39 | 39 19 | 58 78 | 2 3 |
| 2 4 | 8 89 | 17 78 | 26 67 | 35 56 | 44 44 | 53 33 | 62 22 | 71 11 | 80 00 | 10 67 | 16 00 | 21 33 | 32 00 | 42 67 | 64 00 | 2 4 |
| 2 5 | 9 26 | 18 52 | 27 78 | 37 04 | 46 30 | 55 56 | 64 81 | 74 07 | 83 33 | 11 58 | 17 36 | 23 15 | 34 72 | 46 30 | 69 44 | 2 5 |
| 2 6 | 9 63 | 19 26 | 28 89 | 38 52 | 48 15 | 57 78 | 67 41 | 77 04 | 86 67 | 12 52 | 18 78 | 25 04 | 37 56 | 50 07 | 75 11 | 2 6 |
| 2 7 | 10 00 | 20 00 | 30 00 | 40 00 | 50 00 | 60 00 | 70 00 | 80 00 | 90 00 | 13 50 | 20 25 | 27 00 | 40 50 | 54 00 | 81 00 | 2 7 |
| 2 8 | 10 37 | 20 74 | 31 11 | 41 48 | 51 85 | 62 22 | 72 59 | 82 96 | 93 33 | 14 52 | 21 78 | 29 04 | 43 56 | 58 07 | 87 11 | 2 8 |
| 2 9 | 10 74 | 21 48 | 32 22 | 42 96 | 53 70 | 64 44 | 85 19 | 85 93 | 96 67 | 15 58 | 23 36 | 31 15 | 46 72 | 62 30 | 93 44 | 2 9 |
| 3 0 | 11 11 | 22 22 | 33 33 | 44 44 | 55 56 | 66 67 | 77 78 | 88 89 | 100 00 | 16 67 | 25 00 | 33 33 | 50 00 | 66 67 | 100 00 | 3 0 |
| 3 1 | 11 58 | 22 96 | 34 44 | 45 93 | 57 41 | 68 89 | 80 37 | 91 85 | 103 33 | 17 79 | 26 69 | 35 59 | 53 39 | 71 19 | 106 78 | 3 1 |
| 3 2 | 11 85 | 23 70 | 35 56 | 47 41 | 59 26 | 71 11 | 82 96 | 94 81 | 106 67 | 18 96 | 28 44 | 37 93 | 56 89 | 75 85 | 113 78 | 3 2 |
| 3 3 | 12 22 | 24 44 | 36 67 | 48 89 | 61 11 | 73 33 | 85 56 | 97 78 | 110 00 | 20 17 | 30 25 | 40 33 | 60 50 | 80 67 | 121 00 | 3 3 |
| 3 4 | 12 59 | 25 19 | 37 78 | 50 37 | 62 96 | 75 56 | 88 15 | 100 74 | 113 33 | 21 41 | 32 11 | 42 81 | 64 22 | 85 63 | 128 44 | 3 4 |
| 3 5 | 12 96 | 25 93 | 38 89 | 51 85 | 64 81 | 77 78 | 90 74 | 103 70 | 116 67 | 22 69 | 34 03 | 45 37 | 68 05 | 90 74 | 136 11 | 3 5 |
| 3 6 | 13 33 | 26 67 | 40 00 | 53 33 | 66 67 | 80 00 | 93 33 | 106 67 | 120 00 | 24 00 | 36 00 | 48 00 | 72 00 | 96 00 | 144 00 | 3 6 |
| 3 7 | 13 70 | 27 41 | 41 11 | 54 81 | 68 52 | 82 22 | 95 93 | 109 63 | 123 33 | 25 35 | 38 03 | 50 70 | 76 05 | 101 41 | 152 11 | 3 7 |
| 3 8 | 14 07 | 28 15 | 42 22 | 56 30 | 70 37 | 84 44 | 98 52 | 112 59 | 126 67 | 26 74 | 40 11 | 53 48 | 80 22 | 106 96 | 160 44 | 3 8 |
| 3 9 | 14 44 | 28 89 | 43 33 | 57 78 | 72 22 | 86 67 | 101 11 | 115 56 | 130 00 | 28 17 | 42 25 | 56 33 | 84 50 | 112 67 | 169 00 | 3 9 |
| 4 0 | 14 81 | 29 63 | 44 44 | 59 26 | 74 07 | 88 89 | 103 70 | 118 52 | 133 33 | 29 63 | 44 44 | 59 26 | 88 89 | 118 52 | 177 78 | 4 0 |
| 4 1 | 15 19 | 30 37 | 45 56 | 60 74 | 75 93 | 91 11 | 106 30 | 121 48 | 136 67 | 31 13 | 46 69 | 62 26 | 93 39 | 124 52 | 186 78 | 4 1 |
| 4 2 | 15 56 | 31 11 | 46 67 | 62 22 | 77 78 | 93 33 | 108 89 | 124 44 | 140 00 | 32 67 | 49 00 | 65 33 | 98 00 | 130 67 | 196 00 | 4 2 |
| 4 3 | 15 93 | 31 85 | 47 78 | 63 70 | 79 63 | 95 56 | 111 48 | 127 41 | 143 33 | 34 24 | 51 36 | 68 48 | 102 72 | 136 96 | 205 44 | 4 3 |
| 4 4 | 16 30 | 32 59 | 48 89 | 65 19 | 81 48 | 97 78 | 114 07 | 130 37 | 146 67 | 35 85 | 53 78 | 71 70 | 107 56 | 143 41 | 215 11 | 4 4 |
| 4 5 | 16 67 | 33 33 | 50 00 | 66 67 | 83 33 | 100 00 | 116 67 | 133 33 | 150 00 | 37 50 | 56 25 | 75 00 | 112 50 | 150 00 | 225 00 | 4 5 |
| 4 6 | 17 04 | 34 07 | 51 11 | 68 15 | 85 19 | 102 22 | 119 26 | 136 30 | 153 33 | 39 19 | 58 78 | 78 37 | 117 56 | 156 74 | 235 11 | 4 6 |
| 4 7 | 17 41 | 34 81 | 52 22 | 69 63 | 87 04 | 104 44 | 121 85 | 139 26 | 156 67 | 40 91 | 61 36 | 81 82 | 122 72 | 163 63 | 245 44 | 4 7 |
| 4 8 | 17,78 | 35 56 | 53 33 | 71 11 | 88 89 | 106 67 | 124 44 | 142 22 | 160 00 | 42 67 | 64 00 | 85 33 | 128 00 | 176 67 | 256 00 | 4 8 |
| 4 9 | 18 15 | 36 30 | 54 44 | 72 59 | 90 74 | 108 89 | 127 04 | 145 19 | 163 33 | 44 46 | 66 69 | 88 93 | 133 39 | 177 85 | 266 78 | 4 9 |
| 5 0 | 18 52 | 37 04 | 55 56 | 74 07 | 92 59 | 111 11 | 129 63 | 148 15 | 166 67 | 46 30 | 69 44 | 92 59 | 138 89 | 185 19 | 277 78 | 5 0 |
| 5 1 | 18 89 | 37 78 | 56 67 | 75 56 | 94 44 | 113 33 | 132 22 | 151 11 | 170 00 | 48 17 | 72 25 | 96 33 | 144 50 | 192 67 | 289 00 | 5 1 |
| 5 2 | 19 26 | 38 52 | 57 78 | 77 04 | 96 30 | 115 56 | 134 81 | 154 07 | 173 33 | 50 07 | 75 11 | 100 15 | 150 22 | 200 30 | 300 44 | 5 2 |
| 5 3 | 19 63 | 39 26 | 58 89 | 78 52 | 98 15 | 117 78 | 137 41 | 157 04 | 176 67 | 52 02 | 78 03 | 104 04 | 156 05 | 208 07 | 312 11 | 5 3 |
| 5 4 | 20 00 | 40 00 | 60 00 | 80 00 | 100 00 | 120 00 | 140 00 | 160 00 | 180 00 | 54 00 | 81 00 | 108 00 | 162 00 | 216 00 | 324 00 | 5 4 |
| 5 5 | 20 37 | 40 74 | 61 11 | 81 48 | 101 85 | 122 22 | 142 59 | 162 96 | 183 33 | 56 02 | 84 03 | 112 04 | 168 05 | 224 07 | 336 11 | 5 5 |
| 5 6 | 20 74 | 41 48 | 62 22 | 82 96 | 103 70 | 124 44 | 145 19 | 165 93 | 186 67 | 58 07 | 87 11 | 116 15 | 174 22 | 232 30 | 348 44 | 5 6 |
| 5 7 | 21 11 | 42 22 | 63 33 | 84 44 | 105 56 | 126 67 | 147 78 | 168 89 | 190 00 | 60 17 | 90 25 | 120 33 | 180 50 | 240 67 | 361 00 | 5 7 |
| 5 8 | 21 48 | 42 96 | 64 44 | 85 93 | 107 41 | 128 89 | 150 37 | 171 85 | 193 33 | 62 30 | 93 44 | 124 59 | 186 89 | 249 19 | 373 78 | 5 8 |
| 5 9 | 21 85 | 43 70 | 65 56 | 87 41 | 109 26 | 131 11 | 152 96 | 174 81 | 196 67 | 64 46 | 96 69 | 128 93 | 193 39 | 257 85 | 386 78 | 5 9 |
| 6 0 | 22 22 | 44 44 | 66 67 | 88 89 | 111 11 | 133 33 | 155 56 | 177 78 | 200 00 | 66 67 | 100 00 | 133 33 | 200 00 | 266 67 | 400 00 | 6 0 |
| 6 1 | 22 59 | 45 19 | 67 78 | 90 37 | 112 96 | 135 56 | 158 15 | 180 74 | 203 33 | 68 91 | 103 36 | 137 82 | 206 72 | 275 63 | 413 44 | 6 1 |
| 6 2 | 22 96 | 45 93 | 68 89 | 91 85 | 114 81 | 137 78 | 160 74 | 183 70 | 206 67 | 71 19 | 106 78 | 142 37 | 213 56 | 284 74 | 427 11 | 6 2 |
| 6 3 | 23 33 | 46 67 | 70 00 | 93 33 | 116 67 | 140 00 | 163 33 | 186 67 | 210 00 | 73 50 | 110 25 | 147 00 | 220 50 | 294 00 | 441 00 | 6 3 |
| 6 4 | 23 70 | 47 41 | 71 11 | 94 81 | 118 52 | 142 22 | 165 93 | 189 63 | 213 33 | 75 85 | 113 78 | 151 70 | 227 56 | 303 41 | 455 11 | 6 4 |
| 6 5 | 24 07 | 48 15 | 72 22 | 96 30 | 120 37 | 144 44 | 168 52 | 192 59 | 216 67 | 78 24 | 117 36 | 156 48 | 234 72 | 312 96 | 469 44 | 6 5 |
| 6 6 | 24 44 | 48 89 | 73 33 | 97 78 | 122 22 | 146 67 | 171 11 | 195 56 | 220 00 | 80 67 | 121 00 | 161 33 | 242 00 | 322 67 | 484 00 | 6 6 |
| 6 7 | 24 81 | 49 63 | 74 44 | 99 26 | 124 07 | 148 89 | 173 70 | 198 52 | 223 33 | 83 13 | 124 69 | 166 26 | 249 39 | 332 52 | 498 78 | 6 7 |
| 6 8 | 25 19 | 50 37 | 75 56 | 100 74 | 125 93 | 151 11 | 156 30 | 201 48 | 226 67 | 85 63 | 128 44 | 171 26 | 256 89 | 342 52 | 513 78 | 6 8 |
| 6 9 | 25 56 | 51 11 | 76 67 | 102 22 | 127 78 | 153 33 | 178 89 | 204 44 | 230 00 | 88 17 | 132 25 | 176 33 | 264 50 | 352 67 | 529 00 | 6 9 |
| 7 0 | 25 93 | 51 85 | 77 78 | 103 70 | 129 63 | 155 56 | 181 48 | 207 41 | 233 33 | 90 74 | 136 11 | 181 48 | 272 22 | 362 96 | 544 44 | 7 0 |
| 7 1 | 26 30 | 52 59 | 78 89 | 105 19 | 131 48 | 157 78 | 184 07 | 210 37 | 236 67 | 93 35 | 140 03 | 186 70 | 280 05 | 373 41 | 560 11 | 7 1 |
| 7 2 | 26 67 | 53 33 | 80 00 | 106 67 | 133 33 | 160 00 | 186 67 | 213 33 | 240 00 | 96 00 | 144 00 | 192 00 | 288 00 | 384 00 | 576 00 | 7 2 |
| 7 3 | 27 04 | 54 07 | 81 11 | 108 15 | 135 19 | 162 22 | 189 26 | 216 30 | 243 33 | 98 69 | 148 03 | 197 38 | 296 05 | 394 74 | 592 11 | 7 3 |
| 7 4 | 27 41 | 54 81 | 82 22 | 109 63 | 137 04 | 164 44 | 191 85 | 219 26 | 246 67 | 101 41 | 152 11 | 202 81 | 304 22 | 405 63 | 608 44 | 7 4 |
| 7 5 | 27 78 | 55 56 | 83 33 | 111 11 | 138 89 | 166 67 | 194 44 | 222 22 | 250 00 | 104 17 | 156 25 | 208 33 | 302 50 | 416 67 | 625 00 | 7 5 |
| 7 6 | 28 15 | 56 30 | 84 44 | 112 59 | 140 74 | 168 89 | 197 04 | 225 19 | 253 33 | 106 96 | 160 44 | 213 93 | 320 89 | 427 85 | 641 78 | 7 6 |
| 7 7 | 28 52 | 57 04 | 85 56 | 114 07 | 142 59 | 171 11 | 199 63 | 228 15 | 256 67 | 109 79 | 164 69 | 219 59 | 329 39 | 439 19 | 658 78 | 7 7 |
| 7 8 | 28 89 | 57 78 | 86 67 | 115 56 | 144 44 | 173 33 | 102 22 | 231 11 | 260 00 | 113 67 | 169 00 | 225 33 | 338 00 | 450 67 | 676 00 | 7 8 |
| 7 9 | 29 26 | 58 52 | 87 78 | 117 04 | 146 30 | 175 56 | 204 81 | 234 07 | 263 33 | 115 58 | 173 36 | 231 15 | 346 72 | 462 30 | 693 44 | 7 9 |
| 8 0 | 29 63 | 59 26 | 88 89 | 118 52 | 148 15 | 177 78 | 207 41 | 237 04 | 266 67 | 118 52 | 177 78 | 237 04 | 355 56 | 474 07 | 711 11 | 8 0 |
| 8 1 | 30 00 | 60 00 | 90 00 | 120 00 | 150 00 | 180 00 | 210 00 | 240 00 | 270 00 | 121 50 | 182 25 | 243 00 | 364 50 | 486 00 | 729 00 | 8 1 |
| 8 2 | 30 37 | 60 74 | 91 11 | 121 48 | 151 85 | 182 22 | 212 59 | 242 96 | 273 33 | 124 52 | 186 78 | 249 04 | 373 56 | 498 07 | 747 11 | 8 2 |
| 8 3 | 30 74 | 61 48 | 92 22 | 122 96 | 153 70 | 184 44 | 215 19 | 245 93 | 276 67 | 127 58 | 291 36 | 255 15 | 382 72 | 510 30 | 765 44 | 8 3 |
| 8 4 | 31 11 | 62 22 | 93 33 | 124 44 | 155 56 | 186 67 | 217 78 | 248 89 | 280 00 | 130 67 | 196 00 | 261 33 | 392 00 | 522 67 | 784 00 | 8 4 |
| 8 5 | 31 48 | 62 96 | 94 44 | 125 93 | 157 41 | 188 89 | 220 37 | 251 85 | 283 33 | 133 79 | 200 69 | 267 59 | 401 39 | 535 19 | 802 78 | 8 5 |
| 8 6 | 31 85 | 63 70 | 95 56 | 127 41 | 159 26 | 191 11 | 222 96 | 254 81 | 286 67 | 136 96 | 205 44 | 273 93 | 410 89 | 547 85 | 821 78 | 8 6 |
| 8 7 | 32 22 | 64 44 | 96 67 | 128 89 | 161 11 | 193 33 | 225 56 | 257 78 | 290 00 | 140 17 | 210 25 | 280 33 | 420 50 | 560 67 | 841 00 | 8 7 |
| 8 8 | 32 59 | 65 19 | 97 78 | 130 37 | 162 96 | 195 56 | 228 15 | 260 74 | 293 33 | 143 41 | 215 11 | 286 81 | 430 22 | 573 63 | 860 44 | 8 8 |
| 8 9 | 32 96 | 65 93 | 98 89 | 131 85 | 164 81 | 197 78 | 230 74 | 263 70 | 296 67 | 146 69 | 220 03 | 293 37 | 440 05 | 586 74 | 880 11 | 8 9 |
| 9 0 | 33 33 | 66 67 | 100 00 | 133 33 | 166 67 | 200 00 | 233 33 | 266 67 | 300 00 | 150 00 | 225 00 | 300 00 | 450 00 | 600 00 | 900 00 | 9 0 |
| 9 1 | 33 70 | 67 41 | 101 11 | 134 81 | 168 52 | 202 22 | 235 93 | 269 63 | 303 33 | 153 35 | 230 03 | 306 70 | 460 05 | 613 41 | 920 11 | 9 1 |
| 9 2 | 34 07 | 68 15 | 102 22 | 136 30 | 170 37 | 204 44 | 238 52 | 272 59 | 306 67 | 156 74 | 235 11 | 313 48 | 470 22 | 626 96 | 940 44 | 9 2 |
| 9 3 | 34 44 | 68 89 | 103 33 | 137 78 | 172 22 | 206 67 | 241 11 | 275 56 | 310 00 | 160 17 | 240 25 | 320 33 | 480 50 | 640 67 | 961 00 | 9 3 |
| 9 4 | 34 81 | 69 63 | 104 44 | 139 26 | 174 07 | 208 89 | 243 70 | 278 52 | 313 33 | 163 63 | 245 44 | 327 26 | 490 89 | 654 52 | 981 78 | 9 4 |
| 9 5 | 35 19 | 70 37 | 105 56 | 140 74 | 175 93 | 211 11 | 246 30 | 281 48 | 316 67 | 167 13 | 250 69 | 334 26 | 501 39 | 668 52 | 1002 78 | 9 5 |
| 9 6 | 35 56 | 71 11 | 106 67 | 142 22 | 177 78 | 213 33 | 248 89 | 284 44 | 320 00 | 170 67 | 256 00 | 341 33 | 512 00 | 682 67 | 1024 00 | 9 6 |
| 9 7 | 35 93 | 71 85 | 107 78 | 143 70 | 179 63 | 215 56 | 251 48 | 287 41 | 323 33 | 174 24 | 261 36 | 348 48 | 522 72 | 696 96 | 1045 44 | 9 7 |
| 9 8 | 36 30 | 72 59 | 108 89 | 145 19 | 181 48 | 217 78 | 254 07 | 290 37 | 326 67 | 177 85 | 266 78 | 355 70 | 533 56 | 711 41 | 1067 11 | 9 8 |
| 9 9 | 36 67 | 73 33 | 110 00 | 146 67 | 183 33 | 220 00 | 256 67 | 293 33 | 330 00 | 181 50 | 272 25 | 363 00 | 544 50 | 726 00 | 1089 00 | 9 9 |
| 10 0 | 37 04 | 74 07 | 111 11 | 148 15 | 185 19 | 222 22 | 259 26 | 296 30 | 333 33 | 185 19 | 277 78 | 370 37 | 555 56 | 740 74 | 1111 11 | 10 0 |
| 10 1 | 37 41 | 74 81 | 112 22 | 149 63 | 187 04 | 224 44 | 261 85 | 299 26 | 336 67 | 188 91 | 283 36 | 377 82 | 566 72 | 755 63 | 1133 44 | 10 1 |
| 10 2 | 37 78 | 75 56 | 113 33 | 151 11 | 188 89 | 226 67 | 264 44 | 302 22 | 340 00 | 192 67 | 289 00 | 385 33 | 578 00 | 770 67 | 1156 00 | 10 2 |
| 10 3 | 38 15 | 76 30 | 114 44 | 152 59 | 190 74 | 228 89 | 267 04 | 305 19 | 343 33 | 196 46 | 294 69 | 392 93 | 589 39 | 785 85 | 1178 78 | 10 3 |
| 10 4 | 38 52 | 77 04 | 115 56 | 154 07 | 192 59 | 231 11 | 269 63 | 308 15 | 346 67 | 200 30 | 300 44 | 400 59 | 600 89 | 801 19 | 1201 78 | 10 4 |
| 10 5 | 38 89 | 77 78 | 116 67 | 155 56 | 194 44 | 233 33 | 272 22 | 311 11 | 350 00 | 204 17 | 306 25 | 408 33 | 612 50 | 816 67 | 1225 00 | 10 5 |
| 10 6 | 39 26 | 78 52 | 117 78 | 157 04 | 196 30 | 235 56 | 274 81 | 314 07 | 353 33 | 208 07 | 312 11 | 416 15 | 624 22 | 832 30 | 1248 44 | 10 6 |
| 10 7 | 39 63 | 79 26 | 118 89 | 158 52 | 198 15 | 237 78 | 277 41 | 317 04 | 356 67 | 212 02 | 318 03 | 424 04 | 636 05 | 848 07 | 1272 11 | 10 7 |
| 10 8 | 40 00 | 80 00 | 120 00 | 160 00 | 200 00 | 240 00 | 280 00 | 320 00 | 360 00 | 216 00 | 324 0k | 432 00 | 648 00 | 864 00 | 1296 00 | 10 8 |
| 10 9 | 40 37 | 80 74 | 121 11 | 161 48 | 201 85 | 242 22 | 282 59 | 322 96 | 363 33 | 220 02 | 330 03 | 440 04 | 660 05 | 880 07 | 1320 11 | 10 9 |
| 11 0 | 40 74 | 81 48 | 122 22 | 162 96 | 203 70 | 244 44 | 285 19 | 325 93 | 366 67 | 224 07 | 336 11 | 448 15 | 672 22 | 896 30 | 1344 44 | 11 0 |
| 11 1 | 41 11 | 82 22 | 123 33 | 164 44 | 205 56 | 246 67 | 287 78 | 328 89 | 370 00 | 228 17 | 342 25 | 456 33 | 684 50 | 912 67 | 1369 00 | 11 1 |
| 11 2 | 41 48 | 82 96 | 124 44 | 165 93 | 207 41 | 248 89 | 290 37 | 331 85 | 373 33 | 232 30 | 348 44 | 464 59 | 696 89 | 929 19 | 1393 78 | 11 2 |
| 11 3 | 41 85 | 83 70 | 125 56 | 167 41 | 209 26 | 251 11 | 292 96 | 334 81 | 376 67 | 236 46 | 354 69 | 472 93 | 709 39 | 945 85 | 1418 78 | 11 3 |
| 11 4 | 42 22 | 84 44 | 126 67 | 168 89 | 211 11 | 253 33 | 295 56 | 337 78 | 380 00 | 240 67 | 361 00 | 481 33 | 722 00 | 962 67 | 1444 00 | 11 4 |
| 11 5 | 42 59 | 85 19 | 127 78 | 170 37 | 212 96 | 255 56 | 298 15 | 340 74 | 383 33 | 244 91 | 367 36 | 489 82 | 734 72 | 979 63 | 1469 44 | 11 5 |
| 11 6 | 42 96 | 85 93 | 128 89 | 171 85 | 214 81 | 257 78 | 300 74 | 343 70 | 386 67 | 249 19 | 373 78 | 498 37 | 747 56 | 996 74 | 1495 11 | 11 6 |
| 11 7 | 43 33 | 86 67 | 130 00 | 173 33 | 216 67 | 260 00 | 303 33 | 346 67 | 390 00 | 253 50 | 380 25 | 507 00 | 760 50 | 1014 00 | 1521 00 | 11 7 |
| 11 8 | 43 70 | 87 41 | 131 11 | 174 81 | 218 52 | 262 22 | 305 93 | 349 63 | 393 33 | 257 85 | 386 78 | 515 70 | 773 56 | 1031 41 | 1547 11 | 11 8 |
| 11 9 | 44 07 | 88 15 | 132 22 | 176 30 | 220 37 | 264 44 | 308 52 | 352 59 | 396 67 | 262 24 | 393 36 | 524 48 | 786 72 | 1048 96 | 1573 44 | 11 9 |
| 12 0 | 44 44 | 88 89 | 133 33 | 177 78 | 222 22 | 266 67 | 311 11 | 355 56 | 400 00 | 266 67 | 400 00 | 533 33 | 800 00 | 1066 67 | 1600 00 | 12 0 |

# Annual Meeting of the American Foundrymen's Association and the American Institute of Metals

The 18th annual convention of the American Foundrymen's Association was held at the La Salle Hotel, Chicago, Oct. 13 to 16, and in connection with it there were joint and separate meetings of the American Institute of Metals. The registered attendance aggregated over 600. An extensive exhibit of foundry and metal-working machinery and appliances was arranged in the pavilion of the stock-yards, and this attracted a large attendance.

Many of the papers dealt with matters of practical foundry work and with modern ideas of business management in manufacturing enterprises, but there were a number of papers relating to engineering and metallurgical subjects.

## American Foundrymen's Association

Cast Steel—Steel casting was dealt with from different points of view, and a paper by Mr. Hiorth (Christiania, Norway) described "The Electric Induction Furnace and its use in the Manufacture of Steel," the description relating entirely to the Hiorth furnace. A paper on "Electric Steel Castings," by F. T. Snyder (Chicago), showed that there is an increasing use of electric furnaces for melting steel for small castings. The steel costs less to manufacture and is of better quality than that made in fuel-furnaces, the improved quality being primarily in the higher resistance to loads suddenly applied. It is specially advantageous, therefore, for parts subject to shock.

Castings of "electric" steel stand two and three times the number of drop-test blows required to break fuel-melted steel, while the tensile strength of the former is 5000 to 10,000 lb. higher than the latter, both having the same carbon content. The "electric" steel can readily be made very hot, so that thin sections can be poured with satisfactory results. The steel is quieter in the ladle, and is less liable to blow-holes, but has greater shrinkage than crucible or converter steel. As a rule, foundries using this process melt cold scrap in the furnace instead of refining melted iron from a cupola, the former method being the cheaper. The electric process is specially adapted for making alloy steels. A paper on electric furnaces for brass foundries was presented.

A paper by J. H. Ploehn (Davenport, Iowa), dealt with "Openhearth Furnace Design and Manipulation as Adopted for Foundry Work," and one by W. M. Carr (Erie, Penn.), gave some observations on "Miniature or Detachable Openhearth Furnaces." This latter paper gave the results of three years' experience with such furnaces of 1 to 2½-tons capacity per heat. The furnace is cylindrical, and can be detached from the flue connections, being then handled by a crane and moved from mold to mold while the contents are tapped directly into the molds (no ladle being used). A paper by R. A. Bull (Granite City, Ill.), discussed "Difficulties in Pouring Steel Castings," and one by E. R. Swanson (Granite City, Ill.), discussed "The Pattern Shop, with Relation to the Steel Foundry."

Cast Iron—In a paper on "Cast Iron Specifications and Inspection," R. S. McPherran (Milwaukee) advocated greater uniformity as to size of test bars and specified breaking-loads. He questioned the general use of the term semi-steel for cast iron having varying percentages of steel scrap added in the cupola. A study of "Gray Iron for Motor Car Castings" was read by H. B. Swan (Detroit), who showed a number of interesting micro-photographs of different grades of iron, and Robert Crawford (Detroit) had a short paper on "Automobile Cylinder Founding." The manufacture of "Close-Grained Soft Cast-Iron" was discussed in a paper by John J. Porter (Staunton, Va.); he pointed out that for machine work there is a demand for iron which is both soft and close-grained, and while it is true that close-grain goes generally with a very hard iron, it is possible to obtain the desired combination.

Malleable Iron—This material received considerable attention, and in a paper on "Malleable Troubles," Dr. Moldenke (Watchung, N. J.), reviewed some of the special difficulties in this branch of the industry. A lengthy paper by E. L. Leasman (Boscobel, Wis.), presented a study of "The Annealing Process for Malleable Castings," accompanied by several micro-photographs, and one by P. Rodigin (Russia) gave the results of a number of tests in adding various alloy elements to the iron.

Foundry and Furnace Work—There is still much opportunity for improvement in cupola work, and Dr. Moldenke had a paper on "Rational Cupola Melting Practice," as well as one on "The Centrifugal Blower for Foundry Use." This type of blower is more efficient but more expensive, and is best adapted for foundries using the continuous melting process. It has been applied to a very limited extent as yet. A paper by A. W. Belden (U. S. Bureau of Mines) on "Foundry-Cupola Gases and Temperatures" was a reprint of a bulletin covering investigations on this line. In a paper on "Compressed Air as a Foundry Necessity," by A. P. Murray (East Cambridge, Mass.), a review was given of the various applications of compressed-air for hoists, elevation, molding machines, sand screens, rammers, hand tools, spraying devices and blast apparatus, etc. Different forms of compressors were described also.

Pulverized Coal for Furnaces—An interesting paper by W. S. Quigley (New York) dealt with "The Use of Powdered Coal as Fuel." This stated that plants have been installed capable of handling 240 tons per day, and larger plants now being installed can mill, distribute and burn 740 tons per day. These are for metallurgical furnaces for puddling, reheating, pipe welding, annealing, openhearth, etc. The coal must be very dry, with not over 0.5% moisture, and of such fineness that 93 to 95% will pass a 100-mesh sieve and 80 to 85% will pass a 200-mesh sieve. A forge-shop furnace formerly requiring 650 lb. of bituminous coal per hour now consumes only 350 lb. of pulverized coal and heats the work 20% quicker. The cost of installation of a pulverized-coal plant was said to be less than that of a producer-gas plant.

## American Institute of Metals

At the opening meeting of this association, the work of the U. S. Bureau of Standards in regard to ferrous and nonferrous metals was outlined by Dr. G. K. Burgess, an abstract of whose paper appears elsewhere in this issue. A brief paper by L. C. Parsons reviewed the work

of the bureau in regard to nonferrous alloys. Dr. Burgess discussed the nomenclature of such alloys, and deprecated the use of personal or coined names or such meaningless terms as "manganese-bronze."

A paper on "The Boiling of Metals," by Joseph W. Richards, discussed the boiling or vaporization of metals, and the condensation of metallic vapors to metal. Other papers dealt with brass foundries. One of these (by E. F. Bulmahn) related to the advantages of producer-gas furnaces for such foundries, while another (by G. H. Clamer and Carl Hering) described the Hering electric furnace for melting brass. In addition, there were papers on scientific management of foundries and other plants.

## Flood Protection for Lima, O.; Engineers' Recommendations

A report on protective work at Lima, Ohio, to protect the city against inundation by the Ottawa River, has been made by the W. J. Sherman Co., Consulting Engineers, of Toledo, Ohio. The report recommends extensive channel enlargement and correction work. We abstract some of its essential contents in the following:

Flood of March, 1913—From the rainfall record, the engineers adopt the figure of 8.75 in. as the total rainfall for five days, Mar. 23 to 27, 1913, and of this they take 3.40 in. as having fallen in the 24 hr. of Mar. 25. These figures are the actual averages for six observation points of the Weather Bureau, from Lima to Pellefontaine.

The Ottawa River has a drainage area above the Pennsylvania R.R. bridge at Lima of 140 sq.mi. From comparisons with flood figures for other drainage areas, according to older observations, a figure of 90 cu.ft. per sec. per sq.mi. is assumed for this territory, giving a total discharge of 12,600 cu.ft. per sec. at Lima. On the basis of three different runoff formulas, a flood discharge of 12,000 cu.ft. per sec. is obtained, corresponding to 85.6 cu.ft. per sec. per sq.mi. Again, assuming that the total rainfall of 3.4 in. on Mar. 25, ran off, evenly distributed over the whole day, a discharge of 12,800 cu.ft. per sec. is obtained. It is concluded that the actual maximum discharge of the Ottawa at Lima during the March flood was 12,000 cu.ft. per sec.

Further, the engineers design their work for this capacity, thus tacitly assuming that *no greater discharge need be anticipated.*

Velocity of Flow—The engineers compute a flow velocity, during the 1913 flood, of 7.89 ft. per sec., based on Kutter's formula, with a surface slope of 0.00107. They proposed to limit the velocity to 6 ft. per sec.—presumably to avoid scour—and they state that they designed their proposed improvements accordingly.

With the 12,000-ft. discharge and a 6-ft. flow velocity, a waterway of 2000 sq.ft. is required. This the engineers proceed to provide in an enlarged channel; at the same time, however, they propose to improve the river not only in width and depth, but also in slope, by designing various cutoffs and by removing reefs or bars, with the effect of equalizing and increasing the slope.*

Channel Widening—With a view to limiting the amount of property taken, the engineers decide in favor of a channel 125 ft. wide on bottom and 16 ft. in depth. The sides of the channel are to be formed by levees with 2:1 or 3:1 waterside slope, except that in the central area of the city, to avoid encroaching on the valuable adjoining property, concrete retaining-walls are to be constructed. A bridge clearance of 2 to 3 ft. is provided for. The bottom of the regulated channel is to be shaped concave, with center 4 ft. lower than the sides, to handle the dry-weather flow. The river in future is not to carry domestic and manufacturing sewage, however, as this is to be handled by a collector and disposal system, leaving only the storm water to go into the river.

The course of the river is in rock for a good part of its length. The downstream half of the work, being in earth, it is expected to excavate by dredging.

Bridge Reconstruction—Most of the bridges crossing the river in and near the city must be reconstructed, as they give an average waterway of only 1000 sq.ft. and the improvement is to be for double that area. Detail recommendations for the several bridges are made in the report.

Levees—The river channel, as improved, will be leveed along nearly the whole length of 8-9 mi. under consideration. The levee is designed with a top width of 16 ft. (allowing several feet for wear and wash) and side slopes of either 2:1 or (as recommended by the U. S. Engineers) 3:1. The total width of land occupied by the improved channel over outside slopes of levees will be 225 to 300 ft., as compared with about 100 ft. for the width occupied by the river at present. The difference will have to be acquired, except where it is ceded by the owners, which is likely to be the case at a good number of points.

In certain parts of the city a boulevard, and at one point a railway siding, is to occupy the top of the levee.

Retaining Wall—A total length of 10,100 ft. of reinforced-concrete retaining-wall is to be constructed, 5100 ft. on the left bank and 5000 ft. on the right bank.

River Straightening—In the 8-mile length of river considered, a number of cutoffs of curves are planned. They give a total saving of 12,000 ft. or 2.3 miles of distance, as compared with the present course of the river.

In connection with this work, the river is to be dredged and excavated for uniform slope of bottom, the present slope being very uneven, with ridges and pockets.

Low-Water Regimen—To pond the water in low-water periods, two movable dams are projected, one at Collett St. bridge and the other at Main St. bridge. They are to be 6 ft. high, sufficient to flood the river for the entire distance from Collett St. to North St., about 2 miles. Vertical-lift dams are proposed.

Costs—For the entire section of river studied, a length of 9.5 mi. by the present channel (7.2 mi. by the proposed corrected channel), the cost is $1,172,000, with 3:1 waterside slopes to the levees. Various subdivisions of the work can of course be constructed successively, and this is recommended.

*The fact that with cleared and straightened river channel, and with deeper slope, a higher velocity of flow ought to result, is not mentioned in the report. Apparently the engineers consider that extreme floods in the improved channel will not flow faster than 6 ft. per sec., though the March flood had a velocity of 7.89.

**The largest Conveyor Belts** in the world, it is claimed, are being built by the Perdriau Rubber Co., Ltd., of Sydney, N. S. W., for a coal-loading plant at Fort Kembla. The belts are being made after specifications of the Public Works Department; each is approximately 1650 ft. long and will weigh 12 tons, being made up of seven-ply rubber and cotton in one continuous length, without joints, 36 in. wide. When rolled each belt will be too large to pass through the railway tunnels on the way to the port. The conveyor will carry coal about 1600 ft. at a rate of 1000 tons an hour.

# EDITORIALS

## The Prospects of State Highway Administration in New York

With the news of the impeachment and removal from office of Governor Sulzer, of New York, one of the first questions which occurred to many engineers was whether the change in administration in the State would mean another volcanic upheaval in the New York State highway organization.

As many of our readers will recall, the New York State highway work, after being handled in a more or less chaotic manner during the earlier years of activity, was put in the hands of a non-partisan State Commission by a law passed in the administration of Governor Hughes. In the succeeding administration of Governor Dix this law was repealed, and an entirely new set of men were placed in charge of the highway work with results which engineers familiar with the conditions generally agree are most deplorable from the standpoint of the taxpayers and the users of the roads.

Governor Sulzer's administration is at least to be given the credit of placing the State highway work in charge of John N. Carlisle, an officer who appears to have made an honest effort to establish the work on an efficient and economical basis. Elsewhere in this issue is reported the districting of the State and the assignment to the various districts of engineers selected under civil service rules. The time available since the first of the year, however, has been sufficient for Mr. Carlisle and his associates to do little more than reorganize their department and put it in shape for work. Whatever criticisms may be made concerning the present organization, it will certainly be agreed that it is far better for the taxpayers of New York that this organization should go ahead with the work of state highway construction and repair rather than that another revolutionary change should be inaugurated and a new set of officials be installed to learn the whole business over again. The unfortunate results of the last preceding change are still well remembered.

It is, therefore, of much interest to the engineering profession and to all interested in highway work to know that in all probability the organization created under Mr. Carlisle will be permitted to proceed with the work it has undertaken. It is to be noted that Commissioner Carlisle holds office by virtue of a law passed by the present New York Legislature which makes him secure in the tenure of his position for a term of years, subject only to removal under charges. More than this, however, there is reason to believe that in the efficient and honest conduct of his department Commissioner Carlisle will have the support of the new Governor of the State, Hon. Martin H. Glynn, who succeeded to the office on the retirement of Gov. Sulzer. Those who know the vicissitudes to which New York's famous $50,000,000 of good-road construction has been subject in the past, will appreciate the importance of this news.

## The Life of Supports for Large Wood-Stave Pipe

The use of wood-stave pipes for penstocks and other conduits, we believe, has been fully as satisfactory as was expected when we noted its marked increase over 20 years ago. It was logical then to expect that the staves would be nearly as immune from the attack of rot as submerged wood, and today even the most conservative engineers concede a minimum life for a stave pipe which is continually filled with water under pressure, at about a quarter century. However, the very seepage of water which tends to promote long life of the pipe, is unfavorable to the life of most rigid supports, in those cases where the pipe cannot rest on an earth bed. Good examples of the need of such supporting structures are seen in the case of the 13½-ft. wood-stave pipe of the White Salmon River work, described in our issue of Oct. 9, and the semicircular wood-stave flume at the Puntledge River development, described in this issue. There is some experience to warrant the expectation that, under conditions similar to those of the two projects named, the supports will last about ten years, the maintenance costs running up rather rapidly in the last three or four years of this period. We know of some engineers who have employed wood supports for conduits to reduce the investment costs in the early years of struggling developments, expecting to replace them with more permanent substructures (like concrete) when renewal becomes imperative, and when presumably the projects will have secured a sound commercial footing. In all such cases, the original designers need to keep in mind the possibility of piecemeal replacement.

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## A Difficult Point in the Railway Valuation Law

In commenting on the Federal Railway Valuation law at the time of its enactment last March, we strongly criticized those features of the law which require the unearthing of past records to ascertain the original cost of construction and all the past financial transactions with reference to the property. We have recently received from W. W. Gruber, a railway engineer of Cincinnati, a letter in which he sets forth his experience in actually carrying out an investigation of this sort for a short line of railway. We print his letter as follows:

An article in a recent issue of your journal, stating that in the valuation of railroads by the Interstate Commerce Commission the original cost is to be ascertained, brought to mind a piece of work of this nature that the writer undertook to do less than a year ago, while employed in the office of the Engineer of Maintenance of Way of a Terminal Railroad company in the middle West.

This company had 15 miles of main line and about 50 miles of side track, and about 180 acres of real estate including shops and other facilities, the original cost of which the general manager desired to have prepared in detail that he might be in position to furnish any information the Commission might ask for, and also to serve as a check on

any valuation they might make. Instructions to this effect were given to the writer with orders to call upon the accountants of the various offices for any information needed.

First to be considered was real estate. This was covered by about 250 deeds, several of which were for pieces of property that had been bought, sold and later again purchased. There were also receivership deeds and deeds to, and by, trustees all tending to make the work more tedious and uncertain. These conditions were all carefully gone over with a very competent accountant who had been in the service of the company a number of years in the Treasurer's office and other positions, and who was perfectly familiar with the various files from the latest, back to the dust-covered bundles in the attic and storeroom, where the out-of-date records had been kept and the remains of the files from the time of the construction of the road were stored.

From about 1901 to date, the desired information was very easily obtained from records in the Treasurer's office and from reports previously prepared covering this period. The next step was to look through the old files above mentioned, from which fully 50% of the number of deeds had to be accounted for, as no record was ever kept of the transactions of earlier days other than the old letters, vouchers, receipts, etc., which were mixed with various other papers and tied in bundles marked with the period they covered. After five or six days work in a dusty germ-laden atmosphere, less than 20 vouchers and letters had been found. These, however, did not represent the cost of the property represented by that many deeds. It was found that some of them were made only in part payment and in most cases there was no way of determining when all the parts had been found. Most of the vouchers were missing or other methods of payments had been used. Correspondence was found showing that payment had been made, in one or two cases at least by shares of stock. Other deeds were made in favor of trustees or officials who in turn paid the grantor, later making a deed in favor of the company "for $1 and other consideration."

After practically a week's work we had accounted for not more than 15% of the 125 parcels of property of which we had to find the original cost from these old files, and even these were unsatisfactory and unreliable. It was evident we could do no more and therefore we informed the Manager of the results of our search; and convinced him that finding the first cost from original records was not feasible.

Now that we encountered such obstacles in the matter of real estate, where we had before us just the definite thing of which we were trying to find the original cost, it is plainly to be seen how much more difficult it would be to find the original cost of track material, bridges, buildings, equipment, etc., and of the largest item of all, viz., labor, where there are no known quantities to account for, or to guide one in knowing when all these items have been accounted for, as we had when trying to get the real estate cost.

Should the most expert accountant examine every letter, report or record in these old files, he could draw few, if any, reliable conclusions as to original costs. In the first place there were many irregularities in keeping accounts and second there are so many papers missing that the final results could not even be considered approximate.

That this company used reasonably uptodate methods in their system of accounting, and now uses modern railroad methods as far as their needs demand, the writer is certain, as he has compared them with methods used by one of our large trunk lines where he was employed for several years previously.

This company is less than 30 years old and its properties are trifling in size compared to one of the trunk-line railways.

Considering that most trunk-line railways are two or three times as old, and that they are made up of numerous small roads that were built at various times and under different circumstances, when accounts were not as systematically kept as today, and further that these roads kept their records no more carefully and probably made no more effort to preserve them than this Terminal Railway Company did, while beyond a doubt many files were lost in the numerous changes of ownership and many facts were never recorded except in the minds of the construction engineers—taking all these facts into consideration the writer fails to see how the first cost of railroads can be obtained with even approximate accuracy.

It is a well established principle of law that no statute can compel the performance of an impossible task. The insertion of a few words by those who drafted the Federal Valuation law requiring the ascertainment of the original cost of railway property may perhaps compel the expenditure of hundreds of thousands or even millions of dollars' worth of time in useless searches; but it cannot possibly accomplish the end which was sought. Even if this information could be obtained, it would, in our opinion, have little or no pertinent value in connection with the question which the Federal Valuation Board has to determine, viz., the present value of the railways' physical property. There are two alternatives: either Congress should, at its next session, amend the Valuation Law, striking out all the clauses which require the attempted unearthing of past history, or else the Federal Valuation Board will have quietly to ignore this requirement of the law and defend its action on the ground that the requirement was impossible of fulfillment.

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## Water-Purification Progress at St. Louis

In 1866, the late James P. Kirkwood, a noted waterworks engineer in his day, spent some months in Europe on behalf of the City of St. Louis, Mo., with instructions (dated Dec. 11, 1865) to "inform himself in regard to the best process in use for clarifying river waters used for the supply of cities, whether by deposition alone, or by deposition and filtration combined * * * * * so that this Board may be able to appreciate how far the same mechanisms, and the same or similar combinations of materials, are likely to be adaptable to the purifying of the Mississippi water at St. Louis." In a report which was published in book form in 1869 with the title, "The Purification of River Waters," and which for many years was the only book on filtration in the English language, so far as we know, Mr. Kirkwood recommended that St. Louis adopt sedimentation and slow sand filtration. The city went no further than to build settling reservoirs at that time and for some thirty-five years did nothing else to improve the character of its water except to shift the intake from the Mississippi to the Missouri River and provide added means of sedimentation. Since 1901 the efficiency of the sedimentation basins, both as to turbidity and bacteria removal, has been increased by the use of sulphate of alumina as a coagulant.

The ever-increasing water consumption and the constant rise in potable water standards in this country has at last led St. Louis to enter upon the construction of water filters. These filters are described and the events leading up to them are outlined elsewhere in this issue by Edward E. Wall, water commissioner of St. Louis.

The vast difference between the filters which Mr. Kirkwood recommended St. Louis to build and those now under construction by that city afford striking testimony to the remarkable changes in water-supply engineering which have taken place in the past half century. In place of the vast area for the filters themselves and the small army of men which would have been required to clean them were St. Louis now dependent on filters of the type recommended by Mr. Kirkwood, the new filter plant will occupy a relatively small area and will be operated by a few men, aided by a number of efficient mechanical devices.

At the same time it is highly interesting to note that in broad general features of design and operation the same type of filters recommended by Mr. Kirkwood nearly fifty years ago are still in use throughout the civilized world, treating hundreds of millions of gallons of

water a day, all told, and giving most excellent results—but not, again broadly speaking, treating such water as the Missouri River at St. Louis; at least not doing it unaided, or aided by simple sedimentation alone.

Although Mr. Kirkwood recommended the best type of filters then available the operation of that type at St. Louis, as we now know full well, would have been attended with serious difficulties at frequent intervals of highly turbid water, even with more settling reservoir capacity than the city would have felt itself able to provide at that time.

It is the mechanical filter, with its ready means of washing and also its great ally, coagulation, which has made physically and financially practicable the clarification of such highly turbid waters as the Missouri, while at the same time practically eliminating color and bacteria, when such elimination is needed. In addition to all this, St. Louis now has chlorination at its command as an added safeguard against bacterial infection. We understand that this process will be used at St. Louis, and that liquid chlorine instead of hypochlorite will be employed.

To what extent the people or public officials of St. Louis realized that slow sand filters, even when aided by sedimentation, would be seriously overburdened in dealing with such waters as the Mississippi or the Missouri we cannot say.* For one reason or another, but probably more through inertia than anything else, the city did not live up to its light, or, in other words, did not follow the best engineering advice which it sought and secured.

Whatever excuses there may have been in the past for the failure of St. Louis to live up to its light, the city is now to be congratulated for having at last taken the final step which will place it in the rapidly growing sisterhood of cities which enjoy the comfort, convenience and safety of an ample supply of clear, colorless, germ-free water.

*In a foot note to his report, dated April, 1869, Mr. Kirkwood stated that the "public mind of St. Louis, so far as it has been expressed, does not yet seem to consider filtration important."

## Should Fees Be Charged for the Use of Plans by Contractors Estimating on Work?

The Executive Committee of the General Contractors' Association of New York City, on Aug. 6, adopted the following resolutions:

Whereas, certain architectural and engineering firms and corporations have instituted a practice of charging a fee for the use of plans for estimating, and

Whereas, a practice has arisen of supplying an insufficient number of plans for the execution of a contract, and charging the contractor a fee for additional sets necessary for the completion of his contract, and

Whereas, certain private individuals have instituted the practice of requiring a certified check to be deposited with estimates,

Resolved, that the General Contractors' Association is opposed to the practice of paying for the use of plans for the purpose of estimating, and, except in the case of public work, its members should refuse to make any payment for the privilege of estimating, whether under the guise of a deposit, paying the cost of blueprinting, or otherwise, and

Resolved, that the General Contractors' Association is likewise opposed to the practice of making a charge for additional sets of drawings necessary for the carrying out of a contract, and its members should refuse to make any payment for additional drawings or specifications except when drawings are actually lost or destroyed, and

Resolved, that members of the General Contractors' Association except in the case of public work where required by law, should refuse to deposit certified checks or other securities with their estimates.

The point of view from which an engineer should view the questions raised by the above resolutions is the point of view of his client's interest. Is it or is it not for the interest of the client to charge a fee for the set of plans necessary for a contractor to use in order to prepare a close and careful estimate of the work on which he desires to bid? In public work, the letting of which is governed by statute, it is the general practice to furnish sets of plans free to any *bona fide* bidder. Where fees are charged, they are as a rule made nominal, merely to shut out those who desire to secure sets of plans for other purposes than bidding; or it is often the practice to make the fee merely a deposit, to be returned when a *bona fide* bid is filed.

The sound and valid reason for this practice on public work is that the work must be open to free competition, and that the charging of a fee for plans tends to discourage the submission of bids. The practice of requiring a certified check to accompany a bid is, of course, to prevent deposit of bids by irresponsible parties. This is not necessary, however, in the letting of private contracts where the principal or his engineer in letting a contract knows or can ascertain whether the bids submitted are *bona fide*, by responsible firms, and can discard bids from an irresponsible firm without any formality. To require every bidder to submit a certified check with his bid on a private contract, means the tying up of the banking funds of perhaps a dozen or a score of contracting firms for a period of perhaps a week or even a month while the bids are being considered and the award made. Further, misuse of such certified checks by the private parties receiving bids is always a possibility. We see, therefore, no good reason why such deposits should be required.

As for charging a fee for the use of plans required by *bona fide* bidders for estimating, it seems to us that there are few cases where the charging of such a fee will work in the long run to the interest of the party letting the contract. A good way to meet the situation where the detail plans involved in the work are exceedingly elaborate and expensive is to open the plans to inspection and study by contractors and their engineers in the office of the engineer in charge of the work. This can well be supplemented by preparing general specifications and general plans which can be cheaply reproduced in quantities by the phototype process and furnished free to any contractor who desires to look over the work in a preliminary way to decide whether he wishes to submit a bid.

We believe a little careful study of this matter by engineers will enable them to solve this problem to the advantage of both their clients and the contracting fraternity. It is no doubt true that a large expense is often incurred in making numerous sets of large blueprints for the supply of a large number of bidders on contract work. To charge a fee for these prints, however, simply distributes this burden to a number of contractors, only one of whom receives any return from the expenditure.

# LETTERS TO THE EDITOR

## The Need for Proper Inspection of Sewer Connections

Sir—From the installation of its first sewers in 1895-6 until last March this town allowed any person to lay house connections, subject to rules laid down by the department and subject also to a more or less perfunctory inspection for which a fee of $2 was charged, the inspector receiving the same. In many cases this was a ridiculously low figure to secure the services of a careful and competent inspector and since the town began, dating some time in April, 1913, to do the work itself, at cost to the abutter, there have been some corroborations of the need of a change.

One such came to light within a week. A connection which had been troublesome was uncovered, when it was found that some of the pipes were far enough apart at the joints to permit the insertion of one's finger. The plausible explanation is, it would seem, that backfilling was carried too far before the cement was sufficiently set. The soil is very wet in wet times, and was consequently heavy and slippery and tended to slide toward the house end of the trnch, carrying the pipe with it.

Very likely others of your readers have seen similar cases; it serves to emphasize more strongly the importance of rigid enforcement of specifications as to all details in this line of work.

NORMAN M. PAUL,
Clerk, Board of Sewer Commissioners.

Fairhaven, Mass., Oct. 16, 1913.

## The Purification of Panama Water-Supplies

Sir—I have read with much interest the article on "Panama Water-Supply and Purification Systems," in your issue of Oct. 2, 1913. Permit me to say that the article gives too much credit to the air treatment in comparing the plants at Agua Clara and Mt. Hope. The air treatment is absolutely necessary to the reduction of odors, beyond which its usefulness is doubtful except when treating the lower layers of reservoir water, which is an expensive experiment.

There are several things to be considered in comparing these two plants. First the type of filters: a gravity filter against a pressure filter through which the water is forced by a reciprocating pump at 70 lb. and with a loss running up to 8 or 10 lb. The pulsations of the pump are very noticeable in the filter building. The age of the reservoirs has no small effect and despite the proximity of the two watersheds there is considerable difference in the characteristics of the two waters. The mixing arrangements present a very important difference, that at Gatun being much more efficient. The mixing of chemicals with these waters must be instant and violent. The delay of a second or two between application and mixing prevents the proper precipitation from taking place. Small successive doses are without effect as to coagulation.

By treating separate volumes of water with different quantities of sulphate of alumina, we find that complete precipitation is produced by a dose 0.1 grain per gal. greater than a dose which produces absolutely no precipitate. This minimum effective dose reduces the color in Brazos water to approximately 10 p.p.m., the minimum dose.

My theory of the low-alkalinity consumption by aluminum sulphate is that the chemical, although an acid salt, is absorbed, to some extent, in the nature of a mordant by the vegetable coloring matter.

Of the condition of the iron I may say that Brazos water was dialized on June 11, 1909, when in its worst condition. The total iron (Fe) was 3.4 p.p.m., of which 2 p.p.m. passed the dializer and 1.4 p.p.m. were retained.

The preliminary treatment plant described as at Mt. Hope, is not at Mt. Hope but was a temporary plant built in an emergency on my recommendation at Cocoli, on the opposite side of the Isthmus.

The Mt. Hope preliminary plant consists of duplicate concrete storage tanks, float tank, and a 400,000-gal. basin having 20 sides and divided into eight compartments. The water takes a course similar to a figure 8, being thrown alternately to the center wall and the outside wall to increase the length of its course. The inlet and outlet are within two feet of each other.

The chemical feed is entirely by gravity both at Cocoli and Mt. Hope. The chemical is weighed and put into the old pressure solution tanks and a stream of water under pressure is passed through the tanks, discharging into the elevated storage tanks through 1½-in. copper pipe. The solution is readily effected and the flow of water continued up to a predetermined volume in the storage tanks.

This system might be useful in many plants as it does away with trouble some chemical pumps cause. It was first used, so far as I am aware, by the writer at the Mt. Hope plant here mentioned. It was described before the American Water Works Association in 1910 and later before the Canal Zone Medical Society in a paper on "Canal Zone Medical Supplies."

JOHN R. DOWNES,
Chemist in charge, Mt. Hope Filter, 1907-'09; Physiologist in charge, Zone Water-Supplies, 1909-'13.

Plainfield, N. J., Oct. 14, 1913.

## Neglected First Principles of Masonry Dam Design

Sir—George Holmes Moore, in his article in ENGINEERING NEWS of Sept. 4, 1913, p. 442, gives the most concise and lucid exposition of the First Principles of

Masonry Dam Design that the writer has yet seen published. He is certainly right in saying:

If it is doubted that the foregoing analyses, and the sections resulting from them, are an index of the coming standards of gravity-dam design, an inspection of all recent sections of high-gravity dams will reveal the slow change to more and more ample sections.

This "more ample section" cure for the things that make dams fail is the only one for dams that rely on their weight alone for their stability, and the one great difficulty, uplift, increases directly with the cure, making it quickly come to the point of being prohibitive in cost.

Mr. Moore strikes the key note of the trend of thought where he says:

Finally, he who reads may reckon that there is food for thought in the serious consideration given to types of dams which are as far removed as possible from dependence upon simple gravity. * * * * No failure of any [arch] dam has ever been recorded. No arched dam of any size or pertentage has ever failed. Surely this should be sufficient and final.

The next move, then, should be to get at the design of a dam that automatically eliminates the difficulties that are inherent in the "gravity dam." Of what force and interest are "uniformly varying uplift," "full uniform uplift," "sliding," "overturning," etc., when in the perfected type of structural dam all these dangers and difficulties are automatically eliminated from the problem? Why trouble over long and intricate formulas for keeping the resultant within the middle third when it can be placed and kept at the exact middle of the base and all eccentricity of loading eliminated?

The answer lies in the use of a structural dam designed on scientific basic principles, the design to include the arch and the pyramid, wherein the water pressure itself is used to assist the weight of the structure to give it absolute stability, to the end that as nearly as may be all the stresses are resisted with an equal safety factor, and sliding, overturning and uplift are eliminated. Such a structure will contain the minimum of material because of the even distribution of the stresses, and hence will give higher safety factors in all parts at a less cost than for any other type of dam. There is no type of structure for the barrage of water that can be so readily adapted to meet any set or combination of conditions as the perfected multiple-arched dam, either as to length of crest, height of head or as to the character of the foundations. Where all other types have reached their limitations, either through cost or stresses, the multiple-arched type is still in the running, when the design is varied to suit the conditions.

The single-arched dam soon reaches the end of its usefulness for it is true that for a valley of great width, the long radius required will set up greater stresses than would be set up in a gravity dam of straight section, containing less material, but the point of safety is another thing. For equal stresses this may be true, because we load masonry to such a small fraction of its ultimate crushing strength, but the arched dam of long radius and high stress will stay put long after the straight section has failed, because it cannot fail till it crushes, and the safety factor against crushing is many times that for overturning or sliding in a straight section.

Only by the use of a wide base can there be safety in a gravity dam, and a wide base means a big bond issue.

JOHN S. EASTWOOD.

Hearst Bldg., San Francisco, Calif.,
Oct. 10, 1913.

**The Diesel Oil Engine Ship** "Wotan," which arrived in New York Oct. 4, completing her maiden voyage across the Atlantic, is the largest single-screw oil motor ship yet built. The "Wotan" is an oil-carrying tank vessel 123.14 meters long, 16 meters beam and 9 meters draft (412x52.5x29.5 ft.). She was built for the German-American Petroleum Co., of Hamburg, by the Reihersteig Ship & Machine Works, of Hamburg. The Diesel oil engines which propel her were consructed jointly by the builders and by Carels Freres, of Ghent, Belgium. An excursion to inspect the vessels at the Standard Oil Wharves, Bayonne, N. J., took place on Oct. 6, under the leadership of W. R. Haynie, American representative of Carels Bros. The growing confidence in the reliability of the Diesel engine for use at sea is shown by the fact that the ship is built as a single-screw vessel, while all previous large motor vessels have twinscrews.

The "Wotan's" engine has six cylinders of 600 mm. diameter and 1100 mm. stroke (19.7x36.1 in.) operating on the two-stroke cycle. At 90 r.p.m. the main engines can develop about 2500 hp. (metric) giving the ship when fully laden a speed of 9½ to 10 knots. On her maiden voyage an average speed of 8¼ knots was maintained, consuming about 7 tons of fuel oil per hour and the voyage was made in 18 days. The engines were not stopped during the entire voyage. Her oil bunkers carry fuel enough for a voyage of 30,000 nautical miles. Levers from the main engine drive circulating pumps for the jacket water, bilge pumps and pumps for the scavenging air. A Reavell four-stage air compressor on the main shaft furnishes the high-pressure injection air. An auxiliary four-stroke cycle Diesel engine can drive either an air compressor or an electric generator as required. A donkey boiler, oil-fired, furnishes steam for operating the steering machine, anchor winches and various auxiliary machines when entering a port.

**Change in the Panama Canal Organization and the History of the Central Division**—The Central division of the Panama Canal organization was abolished at the close of business, Friday, Oct. 10, the day the Gamboa dike was destroyed and the waters of Gatun Lake allowed free access to the canal prism through Culebra cut.

The Central division was first organized on July 1, 1909, succeeding the Department of Excavation and Dredging, and was assigned the canal territory extending from the south toe of Gatun dam to the north end of the lock site at Pedro Miguel, a distance along the axis of the canal of 31.69 miles.

The Canal Work was divided into five construction districts, and was placed in charge of Lieut-Col. D. D. Gaillard, as Division Engineer, with the following assistants: Louis K. Rourke, Assistant Division Engineer; A. S. Zinn, Resident Engineer; Mark W. Tenny, R. W. Hebard, W. L. Thompson and George H. Ruggles, Assistant Engineers. Of the Division Engineer's assistants at that time, only two, Messrs. Zinn and Tenny, are now connected with the organization.

With the resignation of Mr. Rourke on May 1, 1910, a reorganization of the work was effected. The position of Assistant Division Engineer was abolished, and that of General Superintendent of Construction created. The five construction districts were consolidated into four.

On May 10, 1911, the engineering branch of the division was reorganized. Previous to this time, the field and office work had been handled by the Resident Engineer at Empire, with offices in charge of Assistant Engineers at Las Cascadas and Paraiso. The two latter offices were abolished, and their work transferred to the office of the Resident Engineer at Empire.

The Chagres district of the division was abolished on Aug. 19, 1912, and the title of it changed to the Relocation Dumps.

The following changes in organization were made effective Oct. 11, 1913:

All surveying work was transferred to W. G. Comber, Resident Engineer, Sixth division, under whose supervision excavation in the wetted prism will be completed by dredging.

Transportation forces were transferred to the Second division of the Chief Engineer's office, under the supervision of the Superintendent of Transportation, who also now has supervision of transportation in the First division, the Fifth division, and the transportation forces of the Fortifications division on the Pacific side.

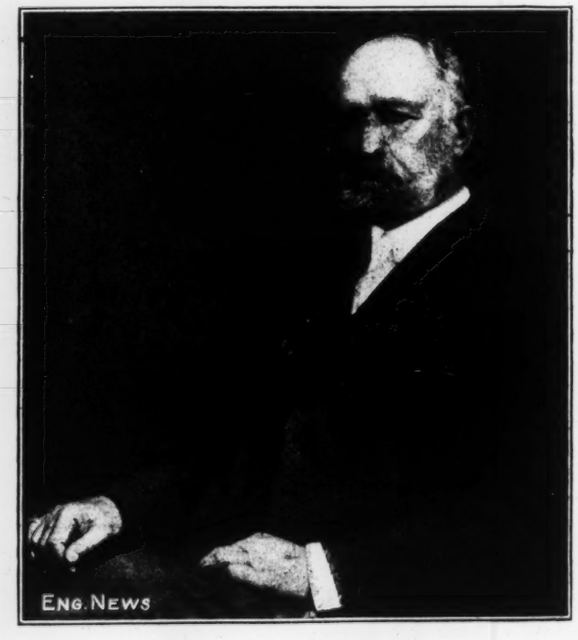
The steamshovel and other construction work of the Central division outside the wetted prism was transferred to Chief Engineer's office, A. S. Zinn, Resident Engineer, reporting to the Chief Engineer. The force under Mr. Zinn will be carried on the rolls of the Chief Engineer's Office.

Of the three great construction divisions organized on July 1, 1908—Atlantic, Central and Pacific—only one, the Atlantic, under Lieut.-Col. W. L. Sibert, remains in existence. The Pacific Division was abolished upon the resignation of S. B. Williamson, its Division Engineer, on Jan. 1, 1913. ["Canal Record."]

# Brigadier-General Dan C. Kingman, Chief of Engineers, U. S. A.

The new Chief of the Corps of Engineers, U. S. A., Dan C. Kingman, who succeeded Brig.-Gen. William T. Rossell, Oct. 11, comes to the head of the Corps after 38 years of service and with 2½ years to serve before he will have reached the age limit of 64, at which Army Engineer officers are retired.

Dan C. Kingman was born Mar. 6, 1852, at Dover, N. H. His father was John W. Kingman, whose ancestors settled in Massachusetts Colony in 1635. John W. Kingman graduated from Harvard University in 1813 and studied law in the office of Daniel Webster. During the Civil War he served as Colonel of the 15th New Hampshire Volunteers, and was afterward Associate Justice of the United States Court of the Territory of Wyoming.




Dan C. Kingman

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The son, Dan C. Kingman, graduated from the United States Military Academy at West Point, the second in his class, in 1875. For three years following he was assigned to duty with the engineer troops at Willets Point, N. Y., as Second-Lieutenant. One of his first experiences in engineering work was an examination and report, under Gen. Q. M. Gilmore, of the condition of the Washington Monument, Washington, D. C., which had then been for several years in an unfinished state and was found to be out of plumb.

Lieut. Kingman was commissioned First Lieutenant in 1879 and for three years was instructor in civil and military engineering at the Military Academy. He was then sent to Omaha, Neb., as Engineer Officer of the Department of the Platte, where he remained for five years, making explorations and surveys for military roads in Nebraska, Wyoming, Utah and Idaho. In 1883, he was selected by Gen. Sheridan to take charge of the roads and bridges in the Yellowstone National Park, and while on this assignment prepared plans for the development of the park which have since been carried out with little variation.

In 1886, Lieut. Kingman was promoted to the rank of Captain and ordered to New Orleans for duty under the Mississippi River Commission. He was given charge of the district from Vicksburg to the head of the passes at the mouth of the river. In 1890, he had charge of the protective works against the greatest flood which had occurred up to that time; and for his services in this emergency he received the thanks, by a joint resolution of the Senate and House of Representatives, of the State of Louisiana.

From his Mississippi River work he was ordered to Oswego, N. Y., to take charge of the harbor work on the south shore of Lake Ontario, and the fortifications at Oswego and Niagara. In 1895, he was placed in charge of the improvement of the Tennessee River and its tributaries. While on this work he supervised the construction of the great masonry lock at Colbert Shoals. In 1897, he was promoted to the rank of Major.

In 1901, Maj. Kingman was transferred to Cleveland, Ohio, where he had charge of the harbor-improvement work on the south shore of Lake Erie. He was commissioned Lieutenant-Colonel in 1905 and in 1906 ordered to Savannah, Ga., where for the past seven years he has been Engineer of the Southeast Division, in charge of all the coast work from Norfolk, Va., to the mouth of the Suwanee River in Florida. In addition, he has served as a member of the Board of Engineers on fortifications for the Southeast Division and as a member of the National Land Defense Board. He was promoted to be Colonel in 1908.

Gen. Kingman has three sons in the United States Army; Capt. John J. Kingman, Corps of Engineers, U. S. A., at present on duty with the Central Division, at Louisville, Ky.; First-Lieut. Ralph W. Kingman, of the 16th Infantry and Second-Lieut. Frederick E. Kingman, Coast Artillery.

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**The Committee on Hulls and Bulkheads,** Department of Commerce, composed of Rear Admiral W. L. Capps, Chief Constructor and Naval Constructor David W. Taylor, U. S. N.; George Uhler, Supervising Inspector General, Steamboat-Inspection Service; and E. T. Chamberlain, Commissioner of Navigation, which was to prepare recommendations for the use of the American delegation to the International Conference on Safety at Sea, to be held in London, England, on Nov. 12, reported as follows:

A law should be enacted dictating the maximum and minimum freeboard for all classes of vessels. Standards of hull construction should be prescribed after careful investigation by experts, and the rules of classification societies should be treated on their merits and approved or disapproved accordingly. Complete investigation should be made as to what reserve of buoyancy should be provided for in the design of a vessel under certain specified conditions of damage. For transoceanic vessels which are essentially cargo carriers and in which extensive subdivision of the hull by transverse bulkheads would be impracticable, ample boat capacity at the davits on each side should be provided for all persons on board, so that in the event of collision or other accident damaging the boats on one side there would be ample lifeboat capacity on the opposite side for all persons on board. Investigation should also be made and regulations prescribed for certain classes of vessels governing the maximum number of adjacent main compartments which could be flooded without jeopardizing the safety of the vessel.

It is considered necessary to formulate and prescribe rules for spacing, strength and tests of water-tight bulkheads. Bulkhead doors should be controlled from the bridge, yet be capable of operation at the door itself; also, for doors in important water-tight bulkheads, independent mechanical operation from the bulkhead deck is desirable. All lights below the bulkhead deck should be fixed, except under unusual circumstances, due to type and size of vessel and location of the bulkhead deck. In the wake of machinery spaces and other large compartments of certain classes of large passenger vessels, double bottom or its equivalent should extend to the deck above load water line. It is also considered desirable that for such vessels the double bottom should extend not only under the engine room, but also under all main compartments forward and abaft engine and boiler spaces.

Among the American delegates to the conference are: E. T. Chamberlain, Commissioner of Navigation, Rear Admiral W. L. Capps, U. S. N.; Capt. G. F. Cooper, Hydrographer U. S. N., and H. L. Ferguson, General Shipbuilding & Drydock Co.

# Report on the Drainage of the Florida Everglades

An important report on the drainage of the Everglades, in southern Florida, by a board of engineers, has just been made public, although the report itself was submitted on Nov. 12, 1912. The engineers composing the board were Prof. Daniel W. Mead, of Chicago, and the University of Wisconsin; Allen Hazen, of New York City, and Leonard Metcalf, of Boston, Mass. The board received its instructions from V. W. Helm, of Chicago, president of the Everglade Land Sales Co., in the form of a letter dated July 23, 1912. The letter stated that the State of Florida had "undertaken to furnish all necessary main canals for the drainage of the so called 'Upper Everglades'"; that the company was the owner of 70,000 acres of land in the Everglades; and that it wished to know "whether or not the present system of canals as outlined by the State of Florida is sufficient to take care of the runoff from the Upper Everglades as a whole—and particularly of the 70,000 acres owned by us." In case the state's drainage scheme was not sufficient for the purpose just stated the company wished to know both what amplification of the state scheme was necessary, and, in case that amplification was not provided, whether it would be possible for the company to dike its holdings on the north and west sides in such a manner as to protect them, and also what other work would be required on behalf of the company.

We give below the findings and recommendations of the board of engineers together with some other information taken from their report—which we should add has not been printed but has kindly been made available to us through the courtesy of Mr. Helm and Mr. Hazen.

Before taking up the report proper a few statements may well be made regarding the location and character of the Everglades and before doing that it may be said that in its letter of transmittal the board of consulting engineers stated that while it found the drainage of the Everglades feasible from engineering and financial viewpoints, yet the work done and projected by the State of Florida, is in its opinion "totally inadequate."

The Everglades have an area of about 4000 sq.mi. and occupies about half of that portion of southern Florida which is south of Lake Okeechobee. The Everglades are in effect a vast marsh covered with water which varies in area and depth according to the rainfall and associated conditions.

Closely related to the Everglades drainage problem is Lake Okeechobee, which has an area of approximately 700 sq.mi. and a drainage area of about 6000 sq.mi. Prior to 1884, when the canal was cut from the lake to the Caloosahatchee River, the lake had no reliable outlet. The canal now gives the lake direct connection with the Gulf of Mexico.

The high-water level of the lake is about 22 ft. above the sea. Quoting now from the report:

> During high water or the rainy season, the lake discharges into the Caloosahatchee River and overflows its southerly border or margin into the Everglades; but during extreme high water in the Caloosahatchee River, when the lake itself is not at flood stage, a reversal of flow sometimes occurs during local storms of extreme severity on the Caloosahatchee drainage area, and then the Caloosahatchee River is found to discharge not only to the sea, but also into Lake Okeechobee for a limited period of time.

The Caloosahatchee River "is shallow, varying in depth from 6 to 12 ft., more or less, and is sluggish and of meandering type. It is not an important factor in the drainage of Lake Okeechobee * * *."

Not only is the control of Lake Okeechobee an important factor in the drainage of the Everglades, but its possible storage capacity "will become of the greatest importance when the irrigation of these lands is undertaken in the future." The engineers state that once the overflow of the lake is controlled the drainage of the Everglades will become a simple problem and after that the lake will be of greater value as a reservoir for irrigation than as a reservoir for storm-flow equalization purposes.

The report reviews in considerable detail the available meager data relating to the rainfall, runoff and evaporation, directly and indirectly applicable to the Everglades problem. The report emphasizes the need for further data of this kind and for additional surveys and studies before the Everglades problem can be properly solved.

The findings and conclusions of the report of Messrs. Mead, Hazen and Metcalf may now be given:

> FINDINGS—In our judgment, the present system of canals as outlined by the State of Florida is not sufficient to take care of the runoff from the Upper Everglades as a whole.
>
> We find that "to ascertain what amplification of the present system will be required to furnish a satisfactory drainage" will require a large amount of study and investigation, together with extended observations and surveys.
>
> It is manifestly unfair that with your relatively small holdings you should be required to meet the large expense of a full and comprehensive study of the drainage of the entire Everglades, and the Board has, therefore, investigated these matters more particularly with reference to the immediate condition and needs of your property, leaving the more detailed study of the larger problem for future investigation by the State, or by an association of all those interested in the reclamation of the Everglades.
>
> We find that it will be possible to dike your present holdings in such a manner as to make them practically independent of the remainder of the Everglades, and we have determined what additional outlets and canals will be necessary in order to accommodate the runoff from the area involved.
>
> We have, as far as practicable, without undertaking complete investigations and surveys, included in this report specific information as to the canals, laterals, ditches, etc., which should be installed by your company in order to properly drain your specific acreage, assuming that the necessary main canals to tide water will be installed. Your Board of Engineers has also designated such additional main canals and laterals as will be necessary for the purpose, and, in a general way, the routes of such canals on maps submitted with this report.
>
> GENERAL CONCLUSIONS—Without attempting to analyze and pass upon all of the details of the plans for the reclamation of the Everglades as outlined by the Engineers of the Trustees of the Internal Improvement Fund of the State of Florida, or to offer suggestions as to the lines on which the reclamation of the Everglades should be accomplished, certain conclusions can be drawn from the information secured which may be considered as fairly definite.
>
> Your Board of Engineers has reached the following conclusion concerning the reclamation of the Everglades:
>
> 1. The drainage of the Florida Everglades is possible from an engineering standpoint. The various developments along the edge of the Everglades clearly indicate the great agricultural possibilities of the land, and we believe that the value of the land when drained and developed will much more than repay the cost of reclamation.
>
> 2. The work already done by the State, and at present definitely projected, is entirely inadequate for the drainage of the Everglades.
>
> 3. The canals now under construction and definitely projected will afford a more ready channel for the passage of flood water from the lake into the Everglades, and, while possibly benefiting to some extent the lands adjoining Lake Okeechobee, will undoubtedly aggravate the flood conditions along their lower reaches, both in amount and in duration, with the possible exception of certain lands favorably located in immediate proximity to the outlets of the canals. During

dry seasons, the canals will assist materially in the drainage of the lands immediately adjoining them, but the flooding which will follow heavy rains will make the improved conditions during dry weather of little practical value.

4. It is, in the judgment of your Board of Engineers, financially inexpedient to attempt to complete the reclamation of the entire Everglades in the immediate future. On account of the great cost involved, and the large amount of land which would thus be thrown at once upon the market, this vast area cannot be sold and brought under successful cultivation with sufficient rapidity to meet the interest on the capital required and the maintenance charges.

5. The cost involved in the complete drainage of the Everglades will be so great as to render it difficult, if not impossible, even were it expedient, for the State of Florida to furnish the necessary funds for immediate development, and consequently there is no hope for the completion of the work, as a whole, in the near future.

6. The magnitude of the possible future agricultural development of the Everglades will require a great and gradual readjustment of market conditions, railroad facilities, rate adjustments and agricultural experiment work, which will involve much time, capital and labor.

7. For the reasons here given, the reclamation of the Everglades must, in our judgment, be a progressive development. Much of the work can be completed only after the earlier lands are drained and brought under successful cultivation.

8. The complete reclamation of the Everglades will require:

a. The control of Lake Okeechobee: To prevent its overflow and the flooding of the Everglades from this source. To provide storage for ultimate irrigation of the drained land.
b. The construction of numerous drainage canals or channels: For drainage purposes, and ultimately, for the distribution of the stored waters of Lake Okeechobee for the irrigation of the drained land.

9. The drainage of Lake Okeechobee can be better accomplished by the construction of canals practically independent of the canals intended primarily for the drainage and irrigation of the Everglades.

10. The canals required for the drainage of Lake Okeechobee and the Everglades must have many times the capacity and will involve many times the cost of those at present under construction or projected by the State of Florida.

The canals should be much deeper than those under construction or projected by the State. The elevation above the sea of the land to be drained is not great, the available slopes in the canals in any event will be very slight, and the lowering of the ground surface by shrinkage of the soil when drained must be provided for. For effective drainage it is essential that the water level in the canals should be brought substantially to sea level at their mouths. This means that the canals must be deepened so that at their mouths the full discharging capacity will be reached in a prism that is below sea level. The State canals under construction and projected are particularly deficient in this respect, their bottoms being only a little below sea level, and their capacities being reached only with much higher water levels. Effective drainage of parts of the Everglades cannot be obtained by such shallow canals, however wide and numerous they may be.

11. It is apparent that the private lands now owned in the Everglades will not be effectually drained by the work now under way or projected by the State of Florida.

12. If the private lands are to be effectively drained within the immediate future, individual or collective effort will have to be exercised by the land owner. The work will be especially difficult on account of the fact that in most cases the State has sold alternate sections under which conditions any private drainage project will require the drainage of twice the land owned by private parties.

13. To accomplish effective reclamation work, a thorough and comprehensive study of this entire problem must be made. This study should involve a systematic study of rainfall conditions; the investigation of runoff and evaporation on the entire area considered; observations of the rise and fall of Lake Okeechobee, and the discharge of the various outlets from the Lake; study and experiments on the agricultural possibilities of the muck lands; the necessary relation of the water table to the cultivated surfaces; the requirements of irrigation, land shrinkage, etc.; more detailed surveys and examination of various canal routes, especially from Lake Okeechobee to the sea. These data, together with many others which will be found desirable as the study of this great project progresses, will be found essential as a basis for the design of an effective reclamation system, and for the preparation of a comprehensive and adequate plan for the complete control of Lake Okeechobee, and the reclamation of the Everglades.

14. To assist in the immediate reclamation of at least a part of the private and public lands in the Everglades, the coöperation of the State is essential:

a. In the preparation of plans which will admit of progressive reclamation by a union of State and private effort.
b. In the passage of a sound drainage act.
c. In the exchange of lands to permit of the segregation of the holdings of private owners.

15. For practical reclamation work, the available resources of the State can best be devoted largely to the control of Lake Okeechobee, the enlargement of the natural outlets, and the construction of additional outlets from the Everglades to the ocean, and to the progressive construction of adequate drainage channels from the outlets so provided into the interior of the Everglades.

Under the heading, "Runoff Conditions in the Everglades," mention is made of the lack of local data and light is sought from observations on river flows in other parts of the South. The intensity of the rainfall in the Everglades leads the Board of Engineers to conclude that the runoff there will be greater than the runoff in Louisiana. In some drainage districts in that state "which perhaps most nearly parallel the conditions found in the Everglades, the ditches and pumping plants built for drainage purposes are usually based upon a maximum runoff of from ¾ to 1 in. in the 24 hr.," or from 21 to 27 cu.ft. per sec. per sq.mi. of drainage area for areas of 10 sq.mi. or more.

The engineers arrived at the following conclusions as to canal capacities in the Everglades:

We conclude tentatively, therefore, that for complete drainage, when the areas are fairly concentrated, the ditch or canal capacities should provide for a discharge of about 1½ in. per 24 hr., or 40 cu.ft. per sec. per sq.mi. of drainage area on land tracts of 50 sq.mi. or less; not less than ¾ in. per 24 hr., or 21 cu.ft. per sec. per sq.mi. on tracts of about 200 sq.mi.; not less than ½ in. per 24 hr., or 14 cu.ft. per sec. per sq.mi. on tracts of about 750 sq.mi.; and that if the whole drainage discharge of the Everglades were concentrated in a single canal, it would not be safe to estimate upon a capacity at its outlet of less than ¼ in. in depth of runoff per 24 hr., or 7 cu.ft. per sec. per sq.mi. of drainage area.

For immediate construction purposes, it will probably be undesirable to design ditches for the smaller land areas for more than 1 in. capacity in 24 hr. This will probably afford ample drainage under most conditions, but may result in limited overflow during occasional heavy storms.

The provision of drainage facilities sufficient to remove the maximum floods would not be warranted.

An important conclusion of the Board is that the flood waters of Lake Okeechobee must be controlled by canals devoted chiefly to that purpose, since this control cannot be effected by "long canals designed for both the drainage of the lands of the Everglades and for the control of Lake Okeechobee." Moreover, the Everglades drainage canals should be so designed or supplemented with additional canals that the irrigation waters from the lake may be brought to the lands for that purpose.

As to the amount of flood water to be removed from Lake Okeechobee and the capacity of canals needed to control the lake, the latter being independent of the drainage district south of the lake, the report of the Board may be quoted as follows:

It is the opinion of your Board that the amount of water to be removed from Lake Okeechobee during floods will not be less than ¼ in. of runoff per 24 hr., and that it may be, in fact, considerably greater in exceptional rains; but during a considerable period of years, while the development of the Everglades is taking place, and during which the water of the lake is not used for irrigation, it will be possible to ordinarily hold the lake level at a low stage, and to use the storage in the lake temporarily for flood waters. Under these conditions half the flood flows, more or less, may be stored temporarily, and canals having a smaller capacity, or perhaps not more than ⅛-in. runoff per 24 hr. may suffice.

Upon this basis the flood flow to be ultimately provided will be 40,000 cu.ft. per sec., requiring a channel from Lake

Okeechobee to the seaboard upon the shortest practicable route, approximately 1000 ft. wide and 15 ft. in depth below elev. 18 at the lake and 15 ft. below sea level at the point of discharge. For immediate requirements, with storage capacity in the lake utilized for storing flood flows, to be discharged as soon as possible, without holding them for use in irrigation, 20,000 cu.ft. per sec. must be provided for, requiring a canal 500 ft. wide, and of the depth previously mentioned.

In a very tentative way a canal system was outlined as follows:

If, for example, the Everglades were to be drained by a system of canals running east from the west side of the Everglades and provided with proper outlets to the seaboard, and if these canals were spaced three miles apart, allowing each to drain the territory 1½ mi. on each side of it, these canals would drain an area three miles wide and an average of about 50 miles in length, or a total of about 150 sq.mi.

Upon such a long narrow strip, the distribution of the rainfall would probably be such that a runoff of not more than ½ in. per 24 hr. need be anticipated. On this basis, the main canal for draining each of these areas should have, at the outlet, a capacity of

150 sq.mi. × 13.44 cu.ft. per sec. per sq.mi. = 2100 cu.ft. per sec.

Such canals would have a mean slope of about 0.2 ft. per mi., and for the capacity estimated should have at their outlets water sections about 110 ft. wide and 12 ft. in depth.

In the actual plans for reclamation, fewer and larger outlets would naturally be used by the union of a number of these canals into a common outlet.

After laying stress upon the inadequateness of the drainage works begun and projected by the state, and urging that the state funds now available be used for "a thorough study of the entire problem," and to providing "adequate outlets to the ocean through artificial and enlarged natural channels, and to the control of Lake Okeechobee," the engineers say that "the successful reclamation of the private lands within the Everglades is largely dependent upon private effort."

The Board then takes up briefly the work which might profitably be entered upon by the Everglade Land Sales Co. and associated companies in the reclamation of its own lands. Whatever else is done, dikes or embankments must be built around the lands of the company to prevent flooding during high water in the Everglades. By way of a dike, the following is proposed:

It is suggested that a narrow trench, 4 ft. more or less in width, be excavated first on the center line of the proposed embankment, the material being taken therefrom being dumped within the lines of the proposed embankment, and that this trench be backfilled with the best available material taken out of the canal adjacent to the embankment, the construction of which will be carried on at the same time.

* * * * While the material in the embankment will be compacted in considerable measure by the process of construction, it will probably be necessary to build it 2 ft. more or less above the final surface decided upon, which has been placed tentatively by us at an elevation of 5 ft. above the present ground surface in order to allow for subsequent shrinkage.

An embankment section 16 ft. wide on top, with side slopes 1½ horizontal to 1 vertical, and with an 8-ft. berm on the inside of the embankment adjacent to the canal, is suggested. The side slopes of the canal may have to be varied, according to the character of the material traversed by it, but can probably be built as steep as 1 to 1, as we found the embankments of a considerable portion of the canals traversed by us were standing successfully on a slope of ½ horizontal to 1 vertical.

The final height necessary for the dikes or circumferential embankments, will, of course, have to be determined after a careful study of the extreme high-water levels prevailing in the Everglades, with allowance for the influence of the canals which have recently been constructed by the state, or which may be added hereafter.

The Board assumed a shrinkage allowance of about 40% "not only in the embankment, but also in the surface of the ground, with reference to its effect upon the water level which may be maintained successfully in the ditches and canals."

As to methods of drainage, consideration is given to gravity, pumping and the two combined, but no definite conclusion is reached, except that "present indications point to the all-pumping project as likely to be the most practicable and advantageous, although the scheme of drainage in part by gravity and in part by pumping has distinct merit if it is feasible."

While further study is needed to determine whether steam, electric or oil power would be preferable, "present evidence indicates that the steam-driven plant will prove more advantageous under existing circumstances."

## Annual Convention of the American Electric Railway and Allied Associations

The thirty-second annual convention of what is now The American Electric Railway Association was held in Atlantic City, N. J., Oct. 13 to 17, 1913. Coincident with the meetings of this parent association were the sessions of the allied Accounting, Engineering, Claims and Traffic Associations, and the exhibit of the Manufacturers Association. The parent association meetings were held in the afternoons and the special sessions in the morning so that members could attend both. The entertainment program (card parties, concerts, dances, a frolic night and a golf tournament) was arranged by the Manufacturers Association as its contribution to the success of the convention.

The following officers were elected for the several associations at separate sessions:

AMERICAN ASSOCIATION:

President, C. N. Black (United R.R.s of San Francisco); Vice-Presidents: C. L. Allen (Newport News & Old Point Ry.), Syracuse, N. Y., C. L. Henry (Indianapolis & Cincinnati Traction Co.), J. A. Beeler (Denver City Tramway Co.), L. S. Storrs, New Haven, Conn.; Secretary-Treasurer, E. B. Burritt, New York City.

ENGINEERING ASSOCIATION:

President, J. H. Hanna (Capital Traction Co.), Washington, D. C.; Vice-Presidents, L. P Crecelius (Cleveland Ry. Co.), John Lindall (Boston Elevated Ry.), B. F. Wood (Pennsylvania R.R.), Altoona, Penn.; Secretary-Treasurer, E. B. Burritt (Secretary American Association).

CLAIMS ASSOCIATION:

President, W. F. Weh (Cleveland Ry. Co.); Vice-Presidents: W. Tichenor (Terre Haute, Indianapolis & Eastern Traction Co.), Geo. Carson (Puget Sound Traction, Light & Power Co.), Seattle, R. E. MacDonald (N. Y. State Rys.), Rochester; Secretary-Treasurer, B. B. Davis (Columbus Ry. & Light Co.), Columbus, Ohio.

TRANSPORTATION ASSOCIATION:

President, D. A. Hegarty (New Orleans Ry. & Light Co.); Vice-Presidents, M. C. Brush (Boston Elevated Ry), H. A. Nicholl (Union Traction Co.), Anderson, Ind., L. C. Bradley (Stone & Webster), Dallas, Tex.; Secretary-Treasurer, E. B. Burritt (Secretary American Association).

ACCOUNTANTS ASSOCIATION:

President, M. W. Glover (Mobile Light & Ry. Co.); Vice-Presidents, T. P. Kilfoyle (Cleveland Ry. Co.), A. H. Kayser (San Diego Electric Ry.), C. S. Mitchell (Pittsburgh Rys. Co.); Secretary-Treasurer, M. R. Boylan (Public Service Ry.), Newark, N. J.

MANUFACTURERS ASSOCIATION:

President, W. H. Heulings, Jr. (J. G. Brill Co.), Philadelphia; Vice-Presidents, E. H. Baker (Galena Signal Oil Co.), New York City; S. H. Blewett (American Car & Foundry Co.), St. Louis, Mo.; Secretary-Treasurer, H. G. McConnaughy (Dearborn Chemical Co.), New York City.

SESSIONS OF THE AMERICAN ASSOCIATION

The address of the president, G. H. Harries (Arkansas Valley Ry., Light & Power Co.), of Louisville, Ky., was a review of the status of the industry and the progress of the Association. He held that electric railways must expect from now on to have to face the financial impossibility of meeting increasing expenses on present rates; increased fares must inevitably come and he believed the most promising plan to be that of having an inner five-cent-fare district in cities and two-cent surrounding zones a mile apart. Companies were warned to watch the development of the motor bus as a competitor. In the association, an important work had been started with the establishing of a rate-research bureau whose benefits to member companies were recited. A warm appreciation was given of work of the retiring secretary (H. C. Donecker, of New York City, who becomes assistant manager of the Public Service Railway, of Newark, N. J.).

ASSOCIATION WORK—The report of the retiring secretary and treasurer showed a membership of 400 companies representing 80% of the total earning power of the industry; there are also 2900 individual members. The report of the membership committee showed 39 more companies this year, leaving now no city of appreciable size in the country unrepresented.

The Committee on Cost of Passenger Transportation (J. D. Mortimer, Milwaukee Electric Ry. & Light Co., Chairman) presented its plan to establish immediately a "Bureau of Rate Research" and to maintain it for a trial period of three years. The expense of about $7500 per year is to be borne half by the association and half by contributions of member companies. The scope of the work includes (1) determination of factors affecting cost of service, (2) compilation and distribution of operating data and financial results, (3) study of unusual conditions.

The *Aera* Advisory Committee (C. L. Allen, Syracuse, N. Y., Chairman) discussed the first year's issue of the association magazine, outlining a policy to have the magazine disseminate association news, educate members in the problems of the industry, present to the public the railway side of utility controversies, and print articles on operating technique.

EDUCATION—The report of the Educational Committee (Prof. H. H. Norris, Ithaca, N. Y., Chairman) showed that it had kept in touch with technical- and vocational-education development during the year, endeavoring to keep the subject before the members by timely articles in the association magazine *Aera*. The plans previously formulated for employee correspondence courses had not been put into wider service on account of the inattention of company officials to the proposed work.

JOINT POLE LINES—A Committee on Joint Use of Poles (W. J. Harvie, Hagerstown & Frederick R.R., Chairman) brought in a proposed form of contract and a specification for joint use on rental basis. (This is a joint committee with the National Electric Light Association and the American Institute of Electrical Engineers.) There was criticism of both sections of the report, so that it was referred back to the committee for study and re-presentation at the mid-year meeting (January, 1914).

RAILWAY INSURANCE—The Insurance Committee (H. J. Davies, Cleveland Ry. Co., Chairman) reported that it had secured data on experience for the year from only 216 companies and that these showed: $179,881,945 in policies carried; $1,198,564 in premiums paid; $224,895 fire losses; $180,691 recovered or 80.3%; premiums equal to $0.666 per $100; losses $0.1125 per $100; recoveries $0.10 per $100; ratio of loss to premium 18.76%; ratio recovery to premium 15.08%.

ELECTRIC-RAILWAY MAIL—A Committee on Compensation for Carrying Mail (T. H. Tutweiler, Memphis, Tenn., Chairman) reported (1) an abstract of a bill which it expected to have introduced in Congress and (2) a table of estimated costs of mail service on the Boston Elevated Ry.

RELATIONS WITH EMPLOYEES—A report by the Committee on Welfare of Employees (J. J. Burleigh, Public Service Ry., Newark, N. J., Chairman) described the forms of sick benefits, insurance, service annuities and profit sharing which were believed best and recommended the wide establishment of reading, recreation, lunch, bath, sleeping and assembly rooms for employees, and the encouragement of lectures, entertainments and athletic sports. The experience of the Public Service Corporation of New Jersey was cited; its welfare work for 13,420 employees (3654 trainmen) cost $104,800, but resulted in a 31% decrease of employees changes, saving $20 in training each new man, giving decreased accident costs and other economies of keeping experienced men.

W. F. Ham (Washington Ry. & Electric Co.), of Washington, D. C., described the plans in operation by this company giving particular attention to the profit sharing. It had been found that 22½% of gross receipts was absorbed in trainmen's wages and 3½% in accident claims; the company set aside 26% to cover these two items, agreeing to divide the unexpended balance among the employees as extra profits.

H. A. Bullock (Brooklyn Rapid Transit System), Brooklyn, N. Y., outlined advantages found in a self-supporting mutual-benefit association (helped by the company to the extent of giving quarters, equipment, medical service, etc.). Pensions and medical inspection had been established independently by the company; accident benefits and profit sharing had not been established.

Several reports dealt with attempts to secure closer relations between the association and railway employees through sectional organizations. A special Committee on Company Sections (C. N. Duffy, Milwaukee Electric Ry. & Light Co., Chairman) reported inaction on the part of companies and urged the rapid utilization of this aid in developing better employees.

A special Committee on Constitution and By-Laws (C. L. Henry, Indianapolis, Chairman) recommended change in one section to aid in the establishment of sectional associations, by making them non-voting members of the American Association. The organization and conduct of local associations would be promoted by a special committee appointed by the executive committee of the American Association. The report was approved for further action.

PUBLIC RELATIONS—A Committee on Federal Relations (A. W. Brady, Anderson, Ind., Chairman) described a year's activities. It commented in particular on (1) the recent U. S. Supreme Court decision which denied jurisdiction of the Interstate Commerce Commission over street railways, (2) the act for valuation of

property of common carriers, (3) proposed and expected steel-car legislation.

There were three addresses on "Tendencies of Public-Utility Regulation." In the first Frank Hedley (Interborough Rapid Transit Co.), of New York City, remarked that there had not been much "administrative assistance" from the New York Commission but that, after several years' effort, the commissioners had learned much about utility business and had developed a strong tendency toward real coöperation. There was now much real municipal coöperation in urban transportation, participation in subway building being noted in Chicago, Boston, Philadelphia and New York. The public was seeing better the need of protecting capital investment.

Papers by Richard McCulloch (United Rys. of St. Louis) and C. L. S. Tingley (American Rys. Co.), of Philadelphia, gave abstracts of the several state laws and court decisions on which present regulation was based.

The report of the Committee on Public Relations (T. N. McCarter, Public Service Ry., Newark, N. J., Chairman) described conferences with the National Electric Light Association and the appointment of a joint committee to confer with the National Civic Federation in the formulation by the latter of a "model public-utility law." Another joint committee has been appointed to endeavor to mold public opinion in favor of the utilities.

"A Model Utility Law" was the title of a paper by W. D. Kerr (Municipal Publishing Co.), of New York City. He described the organization of an executive council on public-utility regulation by the National Civic Federation and its work which had resulted in a tentative bill which it hoped to publish before another legislative season. Such a bill it was hoped would be of wide service in showing the wisest provisions which various states could adopt, being the joint product of prominent representatives (unofficial) of public bodies and public utilities.

Mr. A. D. B. Van Zandt (Detroit United Rys.) in a paper describing the publicity efforts of this company, stated that they had abandoned newspaper advertising in favor of car posters and a company magazine, 100,000 copies of which were distributed on the cars weekly.

Franchises, Finance, Etc.—"The Cleveland Situation—Its Economics as Developed in the Arbitration Decision of June 19, 1913," was the subject of an address by C. N. Duffy (Milwaukee Electric Ry. & Light Co.), one of the three arbitrators in the recent dispute with the city. He reviewed the ordinance franchise and the reorganization of the company some three years ago. He maintained that a proper study of the situation would show that safeguards for capital investment had not been secured by the governing ordinance, and that no company could maintain its property on the Cleveland fares, give adequate service and earn 6%. The Cleveland service, he held, was inadequate for the growth of the city in both car operation and track extensions. The actual cost of 37 months' operation was some $3,068,000 more than receipts if proper accident and insurance reserves and capital amortization were made. The rate of return (5% on bonds and 6% on stock) was held insufficient; the investment was not properly protected by the ordinance after the termination of the franchise; the depreciation reserve was being collected by a discredited assessment scheme.

A paper "Financial Aspects of Relief of City Congestion by Subways and Viaducts" by C. S. Sergeant (Boston Elevated Ry.), related the conditions under which his company operated. As a result of this experience he contended that only where a large system concentrates great traffic over a long route are subway trains possible, though in some congested centers surface cars might be diverted over or under streets. The burden should be wholly or partly borne by the community benefited. The method of leasing subways to operating companies, with rental a prior charge over dividends on pre-existing investment, was called unfair in that it throws all risk upon the companies.

Paul Shoup (Pacific Electric Ry.), of Los Angeles, described commendable coöperation between towns and interurban railways in southern California, as an example of possible rural development.

A. M. Harris (Harris, Forbes & Co.), of New York, addressed the association on "Electric Railway Securities from the Investor's Standpoint," outlining first the outgrowth of modern bond houses and their function. He noted a persistent public prejudice against traction systems on account of "overestimates of value indulged in while financing consolidations," and said that, on account of this feeling, the banker felt forced to insist on ample safeguards against the peculiar hazards of (1) rapid depreciation and obsolescence, (2) labor troubles, (3) municipal interference and (4) damage suits. Bankers found traction bonds attractive only when net earnings were about twice the interest charges and reasonable dividends were earned on the stock. To safeguard bonds, the traction companies should secure a reasonable public attitude toward their service, be allowed to earn larger rates of dividends, have relief from burdensome taxes and excessive street maintenance, install fare systems that allowed loss on no part of the business, develop more stable relations with employees, safeguard obligations by careful maintenance of property, use better equipment and safety devices and increase vigilance of employees.

In a most thoughtful address, "Franchise Values," W. M. Wherry, Jr. (Wherry & Mygatt), of New York City, showed how the present confusion of statutes, court decisions, commission rulings, etc., arose from lack of good definitions of "franchise value" and insufficient knowledge of the economics of property value. "Value," he contended, is the advantage of possession as distinguished from cost of acquisition, and property has three elements of value, (1) mere possession, (2) marketability, (3) right to profit from use of it. He argued for use of a property value in rate making which would be the same as for condemnation or taxation, and that "value of service rendered" was a better basis of rates than the profits derived. Cost of service could logically be examined only to secure evidence of extortionate profits. In contrast with these views were those that the state could properly (by police power) take away property value to prevent extortion and where unearned increment had been attained without service.

"Other Elements of Value" was the title of an address by C. M. Rosencrantz (Milwaukee Electric Ry. & Light Co.). He first took up physical valuation; accrued depreciation he had found the most disputed item in this, since there was no approved way of finding life of equipment. He believed courts were favoring as "value," the reproduction cost less depreciation. He gave a historical

development of the concepts of going value, working capital, accident and insurance reserves, etc.

### Sessions of the Engineering Association

The address of the president, Martin Schreiber (Public Service Ry., Newark, N. J.), was a brief review of the trend of association work and an argument for extension of membership. The report of the executive committee and of the secretary-treasurer (H. C. Donecker, Secretary of the American Association, New York City) were both informal; it appeared from them that there were over 2000 members and that the cost of running the association was about $4140, exclusive of the printed transactions, cost which is borne by the parent association.

Education—For the Joint Committee on Education, William Roberts (Northern Ohio Traction & Light Co.), of Akron, Ohio, the engineering representative, outlined efforts which were to be made to interest member companies in education of employees to increase personal efficiency and thereby decrease cost of operation.

The Committee on Power Generation presented as its report four descriptive papers, all of which are explained by the titles: "Forcing Boilers for Peak Loads," by B. F. Wood (Pennsylvania R.R., Altoona, Penn.); "Boiler Settings, Furnaces Stokers, Etc.," by W. H. H. Wilson (Pennsylvania R.R., Altoona, Penn.); "Automatic Relays and Apparatus to Protect from Shut-Down," by W. H. Sawyer, J. W. Welsh, and G. C. Hall; and "Distant Control of Valves," by Wm. Roberts (Northern Ohio Traction & Light Co.).

City-Railroad Trains—The report of the Joint Committee of the Engineering & Transportation Associations on train operation for city service (H. H. Adams and W. H. Sawyer, chairman) showed the results of continued efforts from last year to secure data and information regarding train operation on street railways as distinguished from interurban service. The committee reported but few specific trials but these strengthened the theoretical deductions of last year's report that a distinct saving should be made by train operation during certain periods of the day over certain portions of the system in most cities. As an appendix to the report, tests made by the Public Service Ry., of New Jersey, to determine the practicability and desirability of two-car city-train operation in city service are given in considerable detail.

The report of the Committee on Electrolysis (A. S. Ritchie, Worcester, Mass., Chairman) comprised a general discussion of corrosion of underground structures by stray currents, this consisting very largely of extracts from reports of the U. S. Bureau of Standards. There were also several pages on the utility of potential surveys on pipe and on methods for determination of current flow in underground structures, together with a summary of the several available methods of minimizing electrolytic corrosion of varied structures.

In the discussion, H. G. Stott (Interborough Rapid Transit Co., New York) described the inadequacy of the "drainage" scheme (feeder-drain cables from positive pipes, etc., running to the power-station negative busbars) in the experience of the Interborough company with its elevated-railway structures where conditions seemed ideal for this system. They had studied every available system and finally had installed insulated negative-return conductors. This had proved nearly perfect, both on elevated and subway. He believed that for protection of buried structures like pipes a combination of (1) return feeders for the rails and (2) insulated joints for branch pipes and taps would be best. A number of speakers dwelt on the necessity of coöperation between railways and parties affected in securing minimum possible injury.

Electric-Railway Signals—At a joint session with the Transportation and Traffic Association, a report was made by the joint Committee on Block Signals for Electric Railway (J. M. Waldron, Interborough Rapid Transit Co., New York City, Chairman). This committee had been instructed to continue the study of signaling instructions and methods and to make recommendations on use of track circuits and equipment for signaling on suburban and interurban lines. The first definite recommendation was that, for high-speed interurban service, continuous-track-circuit control systems should be used with cheaper form of indicators in preference to less reliable control. Objection was raised to this as shutting the door on the development of signaling—something which the members did not want done in spite of the great advantages of continuous-track-circuit control. The meeting finally adopted a recommendation that "wherever automatic signals were controlled by continuous-track circuits, precedence should be given to cheaper indication in preference to an expensive signal and less reliable control." The second definite recommendation was for light aspects of three-position single-track opposing-protection and car-spacing signals. This was adopted against some slight objection of inadequacy of green as "proceed prepared to stop," it being understood that the Standards Committee would consider both recommendation and objection.

The report gave a number of schemes for signaling double- and single-track suburban and interurban lines, citing them only as instances of practical methods already in use. There was also a digest of block-signal laws in the several states and a long appendix giving descriptions of signal and automatic-stop systems. Another appendix gives a bibliography on block signals for electric railways.

Heavy Electric Traction—The report of the Committee on Heavy Electric Traction (E. R. Hill, Pennsylvania R.R., New York, Chairman) presented some tentative clearances for overhead wires and collector systems of electrified steam roads with the recommendation that the committee continue the investigation of the subject in coöperation with similar committees of the American Railway Engineering Association finally to establish clearances which could be approved by all interested. The committee recommended that since the development of automatic stops was in an experimental stage no further consideration should be given to the location of such devices on the track structure. However, it was recommended that the space between third-rail clearance line and track should be guarded against encroachment since such space would surely be needed for these devices. In all this committee's work it acted jointly with similar committees of the American Railway and American Railway Engineering Association.

Engineering Accounting—At a joint meeting of the engineering and accountants' associations, a joint Committee on Engineering Accounting (J. H. Hanna, Capital Traction Co., Washington, D. C., and F. B. Lasher,

Republic Ry. & Light Co., New York, Chairman) discussed (1) interdepartmental and overhead charges; (2) cost accounting and (3) timekeeping by engineering and accounting departments. The report was largely confined to a description of certain forms found useful in reporting shop costs. The discussion showed a growing appreciation of distributing general organization expense more widely over all work in arriving at an idea of true cost; the practices described showed additions of 7 to 100% on cost of labor and material depending on amount of equipment and supervision required. The engineers present seemed to feel that accountants were not apt to give them the sort of cost data that was needed, while the accountants held that engineers need not dabble in accounting if they would only coöperate by warning in advance of the sort of information needed.

One of the most appreciated reports was that of the Committee on Life of Physical Property (Martin Schreiber, Public Service Ry., Newark, N. J., and R. N. Wallis, Fitchburg & Leominster Street Ry., Fitchburg, Mass., Chairmen). They reviewed the attempts of two previous committees to draw up a life table for street-railway equipment, and discussed the elements that caused differences in life of similar apparatus—use, climate, maintenance, adequacy, obsolescence, human factor, public demand, earnings, etc. They showed that the complexity of each of these elements so affected the useful life that no table could be drawn up which would amount to more than a rough estimate in any specific case. Probable life of property was to be fixed only by careful scrutiny in every case, on account of the important part it played in maintaining integrity of investment and fairness of rates.

In the discussion, William McClellan, of New York City, formerly electrical engineer of the New York Public Service Commission, Second District, and C. M. Larson, chief engineer of the Wisconsin Railroad Commission, approved the committee's conclusion and commended their analysis of affecting conditions. Mr. Larson stated that the Wisconsin Commission had life tables of all utility property, but used them only as a convenient point of departure after actual examination.

Engineering Standards—The Committee on Standards (Paul Winsor, Boston Elevated Ry., Chairman) reported upon the methods, devices, etc., referred to it during the year past (these matters were later presented for further action with the reports of the various originating committees). It also reported the compilation of an "Engineering Manual" containing, in convenient form, all the standard constructions, designs, specifications, devices, the recommended practices, etc. This will be a loose-leaf volume to facilitate annual revision. New procedure for the adoption of standards was reported as revised from the rules made two years ago, cutting out, for instance, letter ballots and substituting approval of the executive committees of this and the parent association.

The report of the committee on Power Distribution (G. W. Palmer, Jr., Bay State Street Ry., Boston, Mass., Chairman) presented a hundred odd pages of specifications, etc., for consideration as "standards" and "recommended practices." These were not quietly passed through but had to endure a searching discussion, though generally with a good defense by the committee. A proposed standard specification for rubber-insulated wire for electric-railway power circuits was referred back to committee; a design of cap-and-cone trolley-wire insulator supports was adopted, as were standard specifications for tubular steel and wood poles and revisions of the specifications for overhead railway crossings of electric-light and power-transmission lines which had been drawn up by a joint committee of the National Electric Light, American Electric Railway, American Railway and other associations and adopted in 1911. Specifications for reinforced-concrete poles were presented for criticism, but without proposal to adopt. Specifications for "recommended practice" in the construction of 600-volt overhead-trolley construction were adopted.

The Committee on Way Matters (J. M. Larned, Pittsburgh Rys. Co.) reported the completion of the work of several past committees in formulating standards for rails. They presented, and the meeting adopted as standard, designs for 7-in. and 9-in. girder grooved rail sections and 7-in. and 9-in. girder guard rails. They brought in as "recommended practice" designs of joint plates for these rails and the meeting so adopted them. It was stated that they were not adopted as standards since such action might seem to discourage use of other types of rail joints. The committee also reported a specification for manufacture of splice bars, which was adopted as "recommended practice"; some revised specifications for openhearth girder and high T-rails, superseding specifications adopted a year ago, were adopted as "recommended practice." It was explained that these last were substantially as before, but showed changes in form desired by the American Society for Testing Materials. There was a little criticism of the standard rail sections as being too light in the base to stand electrolysis and so light in the web as to lead to corrugation in use.

The report of the Committee on Equipment (F. R. Phillips, Pittsburgh Rys. Co., Chairman) presented for criticism and discussion some preliminary outlines of best methods of car wiring, some notes on air-hose troubles and some descriptions and operating data of storage-battery cars. The committee also reported on standard specifications for solid wrought carbon-steel wheels for electric cars, explaining their opposition to the adoption at this time of a standard which, nevertheless, the American Society for Testing Materials had just done. The meeting voted to return the matter to committee for further work. The committee recommended, and the meeting voted, to have the existing standard brake-shoes revised to eliminate minor crudities and to incorporate improvements.

The report of the Committee on Buildings and Structures (R. M. Pinkley, Milwaukee Electric Ry. & Light Co., Chairman) presented (1) a review of present practice in carhouse construction and (2) a set of fire-protection rules. The latter at the suggestion of the Standards Committee were referred back to the committee that they might be put before the National Fire Protection Association to be made consistent with other codes.

## Programs of Other Associations

The following programs of the other affiliated associations are briefly noted as of engineering interest.

### Accountants Association

Reports of Committees: (1) Education—F. J. Pryor, Jr., Chairman (American Rys. Co.), Philadelphia, Penn. (2) Destruction of Records—H. S. Swift, Chairman (Toledo Ry. & Light Co.) (3) Standard Classification of Accounts—H. L.

Wilson, Chairman (Boston Elevated Ry.) 4. Convention of Railway Commissioners—W. F. Ham, Chairman (Washington Ry. & Electric Co.) (5) Prepayment Car Operation, Chairman, M. R. Boylan (Public Service Ry. Co.), Newark, N. J. (6) Fares and Transfers—Chairman, F. T. Wood (New York Rys. Co.) (7) Express and Freight Traffic—F. D. Norviel, Chairman (Union Traction Co.), Anderson, Ind. (8) Express and Freight Accounting—Walter Shroyer (Union Traction Co.), and J. F. Choate (J. G. White Management Corporation), New York, N. Y., Chairmen. (9) Statistical Unit for Car Operation—C. H. Lahr (Northern Ohio Traction Co.), Akron, Ohio, and C. B. Buchanan (Virginia Ry. & Power Co.), Richmond, Va., Chairmen. (10) Best Methods of Collecting and Accounting for Variable Rates of Fare—M. R. Boylan, Chairman (Public Service Ry.), Newark, N. J. (11) Interline Accounting—L. T. Hixson, Chairman (Terre Haute, Indianapolis & Eastern Traction Co.) (12) Coöperating with the U. S. Bureau of Census. A. L. Linn, Jr., Chairman (Harrison Williams), New York. (13) Overhead Charges—P. S. Young, Chairman (Public Service Ry.), Newark, N. J.

Papers and Addresses: (1) "Sinking Funds," W. H. Forse, Jr. (Union Traction Co.), Anderson, Ind. (2) "Statistical Units Used in Analysis of Electric Railway Accounts," J. A. Emery (Ford, Bacon & Davis), New York. (3) "A Unit-Cost Work-Order System," G. W. Kalweit (Milwaukee Electric Ry. & Light Co.) (4) "Accounting Department of Conferences," E. B. Lasher (Republic Ry. & Light Co.), New York. (5) "The Census of Electric Railways," W. M. Steuart (Chief Statistician for Manufactures, Bureau of Census), Washington, D. C. (6) "Overhead Charges," Henry Floy (Consulting Engineer), New York.

### CLAIMS ASSOCIATION

Papers: (1) "Mechanical Devices for Preventing Accidents," J. J. Reynolds and M. P. Spillane (Boston Elevated Ry.) (2) "The Investigation of Street Railway Accident Cases," W. P. Christiansen (Chicago Rys. Co.) (3) "The Prevention of Accidents," H. V. Drown (Public Service Ry.), Newark, N. J. (4) "The Value of Safety Committees," George Carson (Puget Sound Traction, Light & Power Co.), Seattle, Wash. (5) "Motor Vehicles," M. B. Bracken (United Rys. of St. Louis). (6) "Adjustment of Accident Claims," F. D. Edmunds (Interborough Rapid Transit Co.), New York.

### TRANSPORTATION AND TRAFFIC ASSOCIATION

Committee Reports: (1) Individual Membership—L. C. Bradley, Chairman (Stone & Webster), Dallas, Tex. (2) Uniform Definitions—M. C. Brush, Chairman (Boston Elevated Ry.) (3) Rules (Consolidated)—F. A. Boutelle, Chairman. (4) Construction of Schedules and Timetables—J. E. Duffy, Chairman (New York State Rys.), Syracuse, N. Y. (5) Training of Transportation Employees—C. B. Wells, Chairman (Denver City Tramway Co.) (6) Passenger Traffic—J. E. Gibson, Chairman (Kansas City Ry. & Light Co.)

Addresses: (1) "Factors Affecting the Cost of Passenger Service," Edwin Gruhl (Milwaukee Electric Ry. & Light Co.) (2) "Regulations on Sanitation, As Relating to Public Carriers," W. P. Rucker, M. D. (Assistant Surgeon General, U. S. Bureau of Public Health), Washington, D. C.

## NOTES

**The Garbage Disposal Situation in Chicago** has taken another turn. The mayor, who has been opposed to acquiring the plant of the Chicago Reduction Co., has approved an ordinance providing for its purchase by condemnation, although the plant is said to be in such condition that its use can be only a temporary expedient. Experiments with the proposed deodorant treatment have not been very satisfactory, and the proposed reduction treatment with the same chemical appears to have little value. The inventor, J. M. Hirsh, is reported to have declined to allow an investigation of his secret solution by chemists, but he explained some of his ideas at a meeting of the Chicago section of the American Chemical Society. Extravagant statements made as to saving in fuel consumption and recovery of valuable by-products were disproved during the discussion. The situation is now largely in the nature of a factional fight. The people in the neighborhood of the clay pits oppose disposal by dumping, and the people in the neighborhood of the present reduction plant and of proposed new plants, oppose the disposal by reduction. The aldermen represent their wards only and reflect the ideas of their constituents, so that the interests of the city as a whole are practically not represented in the controversy.

**The Rear Collision** on Sept. 2, on the Midland Ry., in England, at Aisgill, was the most serious railway collision which has occurred on a British railway since 1867. Fourteen persons were killed in the collision and ten were seriously injured. A thorough investigation of the accident has been made by the engineer-expert of the Board of Trade, Col. Pringle. The investigation establishes that the collision was due to the failure of the driver of the following train, which caused the collision, to observe the signal set at danger at the entrance of the block in which the train which suffered in the collision was standing. The excuse the driver gave for not observing the signal was that he was busy at the front of the engine oiling the valve motion when he passed the signal and so did not observe it.

The fire which followed the collision and which was at first reported to have been due to the gas lighting system employed, has now been determined to have been set by coals from the locomotive firebox. Such fatal collisions as that at Aisgill are almost unknown in British railway experience. The very low rate of fatality in British railway travel is shown by the statement that according to official statistics of the Board of Trade, the total number of passengers killed in all train accidents from all causes whatever on all British railways during 1912 was only 20. The total number of passengers carried during the year, including holders of season tickets, was 1,294,000,000, exceeding by nearly 25% the total number of passengers carried on all the steam railways of the United States.

**A Troop Train Plunged into a 60-Ft. Ravine,** from the Buckatonna trestle near State Line, Miss., 60 mi. north of Mobile, Ala., on the Mobile & Ohio R.R., on Oct. 19. According to press dispatches 25 soldiers were killed and 100 injured; of the latter, 20 probably will die. The locomotive passed safely over the trestle, but the tender and the three coaches fell through into the ravine, carrying with them four officers and 175 enlisted men of the 170th and 37th companies of the U. S. Coast Artillery stationed at Fort Morgan, Ala., who were going to Meridian, Miss., to attend the Mississippi State Fair.

**The German Dirigible Airship "Zeppelin L-2" Exploded** on Oct. 17, while at an elevation of over 600 ft. above the outskirts of Johannisthal, Germany. The "L-2," which was about 500 ft. in length, was the latest of the aërial war craft built by the Zeppelin Co. for the German navy, and was on her trial trip at the time of the accident. The explosion of the gas bag was followed by that of the gasoline tank, which contained more than a ton of fuel. Of the 28 persons on board at the time, 27 were killed. Those on the ship included the Admiralty board (consisting of a captain, lieutenant-commander, two naval architects, and a naval engineer) and a number of naval warrant officers. Six other Zeppelin airships have been destroyed by fire, explosion, or wreck: "Zeppelin 1," "2" and "6," "Deutschland 1" and "2," and the "L-1." The "L-1" was blown to sea by a violent gale on Sept. 9 and broke in half when she struck the water.

**A Vertical Water-Tube Boiler Exploded** in the generating station of the Richmond Light & Ry. Co., at Livingston, S. I., at 4:30 p.m., on Oct. 21. Six men were killed, four were injured, service on five of the six electric car lines of Staten Island was discontinued (the sixth was operated from the Concord station owned by the same company) and the electric-lighting system of the entire island was out of commission all night. The boiler, which was one of a bank of three Wickes boilers installed in 1901, was blown through the roof of the station and dropped bottom downward into the waters of the Kill van Kull. An explanation of the accident can be obtained only when the boiler is raised and examined. No stop-valves were provided between the several boilers in the battery and the steam, which is carried at a pressure of 180 lb., had to be shut off from the main line. The other boilers in the bank were uninjured except for the damage to the brickwork.

## PERSONALS

Mr. G. N. Howson, Master Mechanic of the Southern Ry., at Princeton, Ind., has been promoted to be Superintendent of the Louisville division, at Louisville, Ky.

Mr. M. J. Wise, Superintendent of the Southern Railway Co., in Mississippi, at Columbus, Miss., has been promoted to be Assistant to the General Manager, with headquarters at Mobile, Ala.

Mr. Henry W. Miller, recently Assistant to the President of the Southern Ry., at Atlanta, Ga., has been elected President of the Kentucky & Indiana Terminal R.R. Co., at Louisville, Ky.

Mr. A. O. Krieger, formerly Publicity Manager of the Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, Mo., has been appointed to take charge of the gasoline-engine sales department of the Whitman Agricultural Co., St. Louis.

Mr. Albert T. Canfield, formerly Architect of the Missouri, Kansas & Texas Ry. system, at Dallas, Tex., has re-entered the service of the Kansas City Terminal Ry., Kansas City, Mo., and his former office at Dallas has been abolished.

Mr. C. E. Denney, Signal Engineer of the Lake Shore & Michigan Southern R.R., at Cleveland, Ohio, has been promoted to be Special Engineer on the staff of the Vice-President in charge of operation, J. J. Bernet, at Chicago, Ill.

Mr. J. E. O'Brien has resigned as Superintendent of Motive Power of the Western Pacific Ry., at San Francisco, Calif., to become Assistant Mechanical Superintendent of the Missouri Pacific Ry. system, with headquarters at St. Louis, Mo.

Mr. Edward St. Clair Smith, Assoc. M. Am. Soc. C. E., County Engineer and Director of Highways at Gooding, Idaho, has been appointed State Highway Engineer of Idaho. A comprehensive system of state highways is to be built in conjunction with the counties.

Dr. Ira N. Hollis, Vice-President, Am. Soc. M. E., was honored by the Massachusetts members of the society on Oct. 17, by a meeting and banquet in Worcester, Mass., where Dr. Hollis has recently entered upon his duties as President of the Worcester Polytechnic Institute.

Mr. Frank H. Flynn, recently Trainmaster of the Boston & Maine R.R., at Boston, Mass., has been promoted to be Superintendent of the Fitchburg division at Boston, succeeding Mr. James D. Tyter, whose appointment as General Superintendent was noted in our issue of last week.

Mr. William T. Donnelly, M. Am. Soc. M. E., Consulting Engineer, New York City, sails from San Francisco, Calif., Oct. 28, for Honolulu, H. I., to make extensive tests of a 5000-ton floating dry-dock for the Inter-Island Steam Navigation Co. He will not return to New York City before the latter part of December.

Mr. Frank M. Williams, M. Am. Soc. C. E., has returned to his home in Goshen, N. Y., having completed the preliminary work for the improvement of 900 miles of highways in Portage County, Ohio. This work is being done under the auspices of the Portage County Improvement Association, organized by Mr. Dan R. Hanna, whose summer home is in this county.

Mr. Charles P. Clark, who recently retired as Vice-President of the Buffalo & Susquehanna R.R., has been engaged by the Massachusetts Public Service Commission as an expert on railway affairs. Mr. Clark was formerly General Manager of the New England R.R., and from 1898 to 1903 he was General Superintendent of the Eastern district of the New York, New Haven & Hartford R.R.

Mr. James G. Woodworth, recently Traffic Manager of the Northern Pacific Ry., at St. Paul, Minn., has been elected Vice-President in charge of traffic. Mr. Woodworth was born at Hillside, Mich., Oct. 31, 1864. His railway experience began when he was 15 years old as an office boy in the general freight department of the Chicago & Northwestern Ry. He was promoted through the freight traffic departments of various Western railways and in 1905 resigned as Assistant to the Vice-President of the Chicago, Burlington & Quincy R.R. to become Traffic Manager of the Northern Pacific Ry.

Mr. Harrison R. Fehr, M. Am. Soc. C. E., President and General Manager of the Easton (Penn.) Transit Co., has been elected President of the Lehigh Valley Transit Co., with offices at Allentown, Penn. Mr. Fehr's engineering experience began at 20 years of age, in 1883, as a rodman with the Lehigh Valley R.R. He was promoted in 1886 to be transitman, and two years later to be Assistant Engineer. From 1891-1899 he was City Engineer of Easton. After several years as a contractor for the construction of electric railways he was made General Manager of the Easton Transit Co., later being elected President.

Maj. Charles De L. Hine has resigned his office of Vice-President and General Manager of the Southern Pacific R.R. of Mexico, the Sonora Ry. and the Arizona Eastern R.R., with office at Tucson, Ariz., to re-engage in private practice as a railway organization expert, with temporary headquarters at Toronto, Ont., where he will be employed by the Canadian Northern Ry. His permanent headquarters will be in New York City. Quite a complete account of Maj. Hine's notable career as an army officer, lawyer, railway trainman and railway executive was published in our personal columns of Feb. 1, 1912, at the time of his election to the general-managership of the Southern Pacific R.R. of Mexico. In recounting his experiences in this capacity at a recent meeting of the St. Louis Railway Club, Maj. Hine gave a very interesting picture of railway operating conditions during the present political chaos in Mexico.

Mr. George H. Benzenberg, Past-President, Am. Soc. C. E., Consulting Engineer, Milwaukee, Wis., has been elected Chairman of the new Milwaukee Sewerage Commission, noted on p. 780 of our issue of last week. Mr. Benzenberg was one of the five citizens originally appointed by the Mayor, but at first declined to serve. Mr. Benzenberg was City Engineer and President of the Board of Public Works of Milwaukee for 17 years, 1882-1899. Under his supervision some of Milwaukee's most important public works have been constructed, including the high-pressure pumping station, the water-works tunnel and intake cribs, the re-design of the city sewerage system, and the Milwaukee River flushing tunnel. He has also been prominently identified as Consulting Engineer with the public works of the cities of Chicago, Kansas City, Cleveland, New Orleans and Cincinnati. The members of the new sewerage commission have many and extensive duties but no salaries.

Mr. John N. Carlisle, Commissioner of Highways of New York State, has announced a complete reorganization of the State Highway Department. The state has been divided into nine divisions, each in charge of a Division Engineer, and a fixed allotment of the state road fund is to be expended in each. Mr. Carlisle has announced the following appointments of Division Engineers:

Mr. Bertram H. Wait, Assoc. M. Am. Soc. C. E., Division Engineer, Board of Water Supply, City of New York, has been appointed Division Engineer of the First division, which comprises the counties of Suffolk, Nassau, Westchester, Putnam, Dutchess, Columbia, Greene, Ulster, Orange and Rockland. The division headquarters will be in Poughkeepsie, and on account of the large amount of highway work on Long Island a Resident Engineer will be located there, who will be in charge of all the work on Long Island; $10,972,000 is to be expended on this division. Mr. Wait is 33 years of age, and was graduated from Cornell University in 1902. He has had charge of the paving work in the city of Syracuse and was in charge of a section of the work under the Rapid Transit Commission in New York City from 1902 to 1907. He has been in charge of water-supply work for New York City from 1911 to the present time.

Mr. Harvey O. Schermerhorn, Assoc. M. Am. Soc. C. E., Resident Engineer, New York State Canals, Terminal Engineer's office, Albany, N. Y., has been appointed Division Engineer of the Second division, comprising the counties of Albany, Rensselaer, Schenectady, Saratoga, Washington, Warren, Essex and Clinton. The division headquarters will be in Albany, and an office of a Resident Engineer will be located at Plattsburg, which will have charge of the work in that section of the Adirondack district; $8,331,000 is to be expended in this division. Mr. Schermerhorn is 33 years old, and was graduated from the Rensselaer Polytechnic Institute in 1903. He has had an extensive experience on the Barge Canal construction, including culverts, bridges and highways. He has been Resident Engineer in charge of Barge Canal construction work in the Erie residency No. 1 at Waterford, and had charge at that place of contract work aggregating $1,700,000.

Mr. Theron M. Ripley, M. Am. Soc. C. E., Resident Engineer, New York State Canals, Fulton, N. Y., has been appointed Division Engineer of the Third division, comprising the counties of Lewis, Jefferson, St. Lawrence and Franklin; the division headquarters are to be continued in Watertown; $6,366,000 is to be expended on this division. Mr. Ripley is 44 years of age and received a special course in civil engineering at Marietta College. His engineering experience covers the supervision of city parks in Manila, P. I., construction work at Marietta, Ohio, and Barge Canal work in New York. He has constructed and paved several streets in Marietta, Ohio, and in Williamstown, W. Va., and was a state representative to the Road Congress in St. Louis during the St. Louis Exposition. He is now in charge of the Oswego residency of the State Engineer's Department.

Mr. James H. Sturdevant, Assoc. M. Am. Soc. C. E., remains Division Engineer in charge of the Fourth division, comprising the counties of Montgomery, Fulton, Hamilton, Herkimer, Oneida and Madison, with division headquarters in Utica; $6,314,000 is to be expended in this division.

Mr. Howard E. Smith, M. Am. Soc. C. E., Resident Engineer, New York State Highway Department, has been appointed Division Engineer of the Fifth division, comprising